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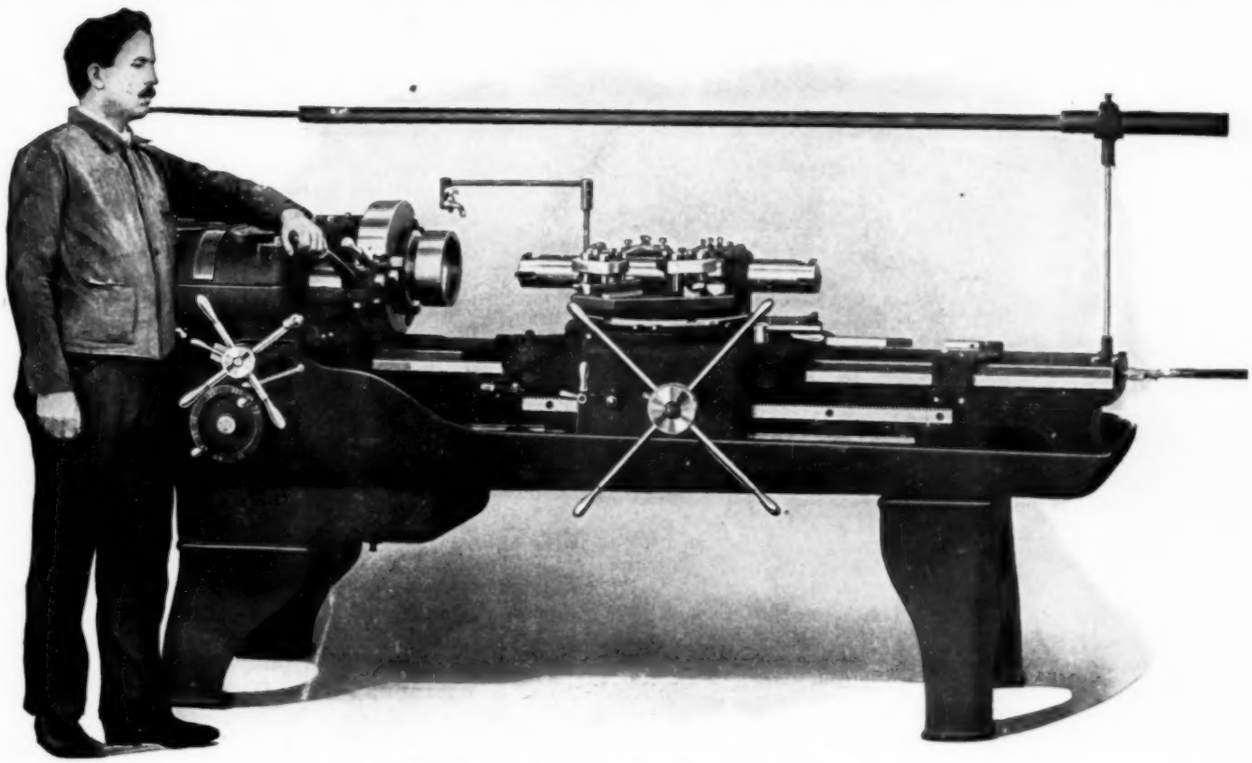

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Turn to pages 12 *and* 13 *and read more details.*

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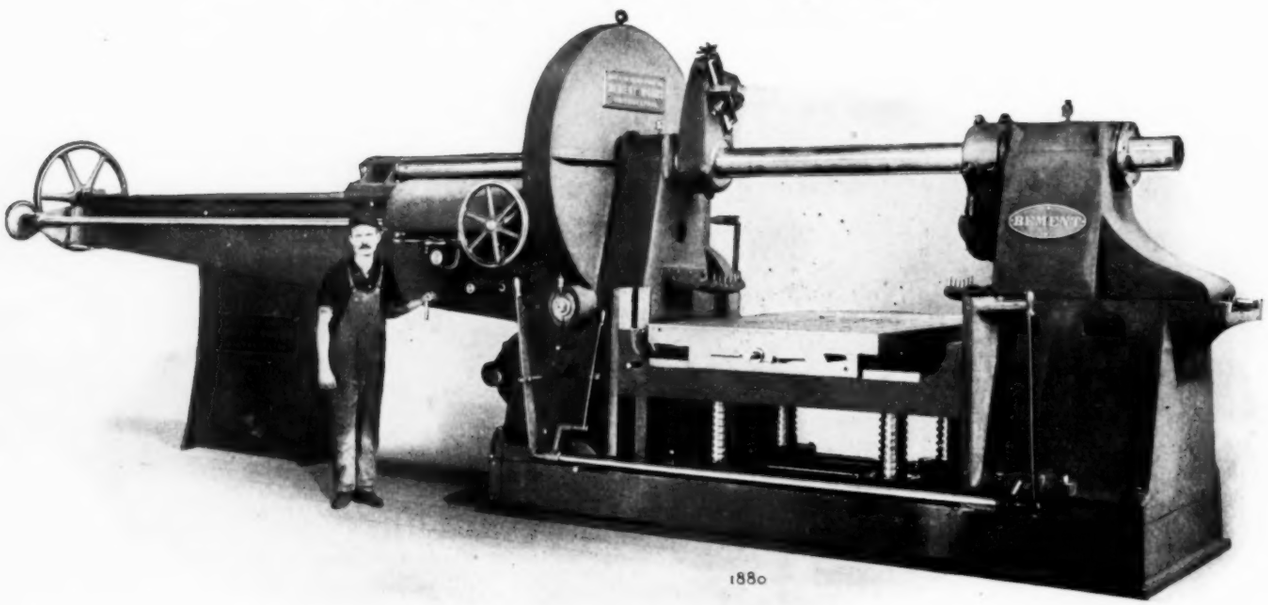
Bement Locomotive Cylinder Borer

With Adjustable Chucking Table



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(*See pages* 51, 52, 53, 54, 55, 56, 57 *and* 58)

Automobile Building Details That Produce Good Results

Milling, Grinding, Boring, Broaching, Turning Operations

Editorial Correspondence

The building of the modern automobile includes so many different operations, running from blacksmithing to dressmaking or its equivalent, upholstery, that it affords opportunity for ingenious methods at every turn. The operations shown in the illustrations which follow are widely varied and all the more interesting on that account. They show a wide range of work and though none of the methods can be called startling, they represent good modern practice and show a careful attention to detail which speaks well for the mechanical ability of the men responsible for the production of the work in the Thomas Motor Company's plant at Buffalo, N. Y., from whom the illustrations have been obtained. Many of the methods can be used in other lines of work or they contain ideas which are of value as suggestions to be applied in different ways.

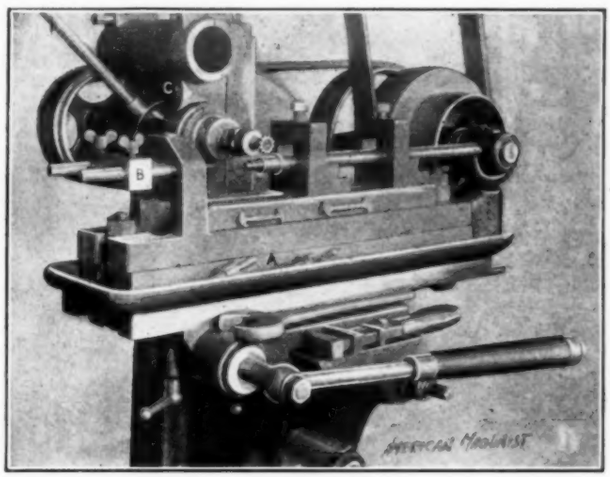


FIG. 1. CUTTING CAM-SHAFT KEYWAYS

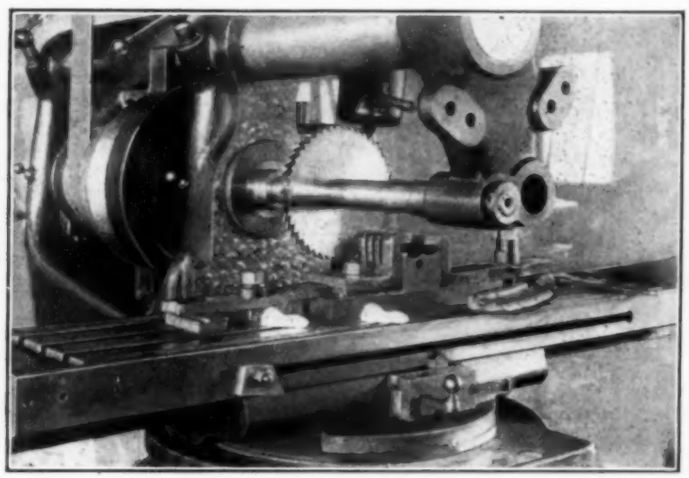


FIG. 2. CUTTING OFF DIVE KEYS

MILLING CAM SHAFT KEYWAYS

A hand milling job is shown at Fig. 1 where a simple fixture is used to mill the keyways in a small cam shaft. As shown the outer keyway is being milled and it is then slipped along to the left until it strikes the crossbar *B* while the locating pin *A* is put down through the bushing *B* until the point of *A* fits into the keyway already cut, which insures the next one being in line with the first. For any other angle and position a different stop and bushing would be used, but this gives an idea of a simple system. Two of the Woodruff keyway gages are also shown on the table.

CUTTING UP IRREGULAR SHAPED KEYS

Irregular shaped stock is not easy to handle and Fig. 2 shows how the drop-forged blanks of the dive or ducking keys shown on the table were held while being sawed up into keyblanks.

The piece is turned with the curved side down and held by the strap on each side, a stop at the back locating the end of the stock and the two saws cutting off two keys at once.

FACING SEATS THROUGH A HOLE

A simple, yet interesting method of facing off the metal around a valve seat, inside a chamber, which can only be reached through a smaller hole, is shown in Fig. 3. The work is the valve seats of a four-cylinder taxicab engine, cast in one piece and having the manifold cast on the cylinder.

The work is mounted on a hand milling machine and the cutter is an end mill that will go through the valve opening which has been previously bored. The mill is put through the hole and the work moved sideways until the cutter shank touches the side of the outside hole, then the cutter is set into the work. The cross and vertical hand levers allow the work to be moved around the shank as a guide until the cutter has faced off the surface surrounding the valve seat. This can be readily understood by referring to the exaggerated sketch shown in Fig. 4. It is a simple proposition after you know how to do it and there are other places where it is likely to be of service.

GETTING FITTED TO AN AUTOMOBILE

Although it is not generally understood, nearly all of the largest factories do more or less custom work in the way of fitting automobiles to their prospective users in very much the same way as builders of ready-made clothing provide for unusual development of the human anatomy.

The great difference in the length of arms, legs and body sometimes makes it more comfortable for the driver if the position, distances and angle of the seat, footboard and steering wheel are made to suit and the machine illustrated in Fig. 6 has been designed for this purpose. It often happens that a very slight change adds considerably to the comfort of the driver and prevents the necessity for the outlandish positions which are often seen.

TESTING TRANSMISSION CASES

Fig. 5 shows the testing stand used, the transmission being tried out in this way with a great load on the two heavy flywheels, which represent the rear wheels of the car. In this way they can be tried out under practically road conditions, using the regular form of control which is mounted on the same stand and connected to the transmission case as in the automobile itself.

In Fig. 7 is seen the lapping stand built for running in the gears which drive the hand shafts and also the worm and sector for the steering mechanism. Helical and herringbone gears are being lapped in at the right and the steering worm at the left. A very ingenious reversing device

is first used on this machine so that as soon as the sector has been turned far enough to lap the last tooth it strikes one of the pins shown and throws a clutch which reverses the motion of the worm until the sector has reached a similar position at the other end of its travels when the operation is reversed.

reaming stands, made up of flat steel bars, are very convenient for this purpose and can be moved to any part of the shop.

Turning Solid Rear Axles

This would be an easy proposition if the wheel bearings at each end were in line and the axles could be turned between centers. As the two ends are not in line, the fixture shown in Fig. 9 is bolted to the face plate and runs in a large bearing at its outer end. The axle is located by its spring pads and the opening in the fixture allows axles to be put in place and removed with perfect freedom, without disturbing the bearing at the outer end of the fixture. Provision is made for oiling this bearing in the shape of an oil cup, which can be seen on top.

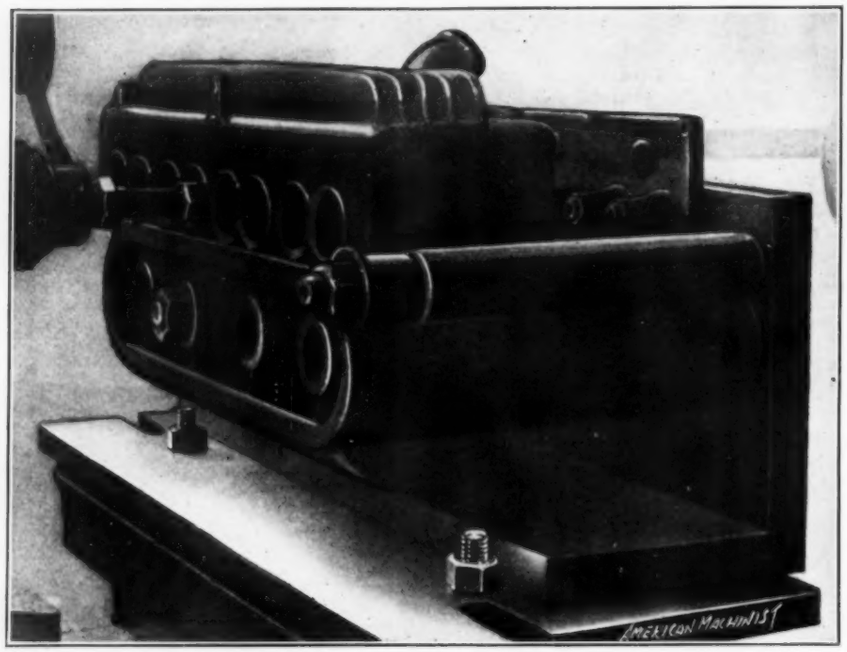


Fig. 3. A Novel Milling Operation

Hand Reaming Machine

In spite of elaborate fixtures for guiding boring bars, all automobile builders know of the difficulty of maintaining the various bearings in the crank case in perfect alinement, as a very slight variation is very noticeable in the proper running of hand-shaft gears after they have been assembled.

To correct any errors that may creep in during the boring operation, the hand reaming fixture shown in Fig. 8 is used and every crank case is hand reamed before going to the assembling department. This is a substantial fixture which is provided with handholes either for lifting by crane or manual labor. Special hand reamers, provided with pilots, are used in this operation, with the result that the assembling is made much easier and more satisfactory in every way. The

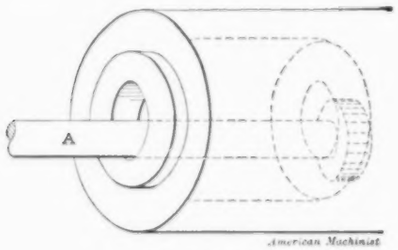


Fig. 4. How It Is Done

Boring Out Connecting Rods

The common method of boring connecting rods is shown in Fig. 10 and requires very little explanation. Four spindles of a multiple drill are used in connection with proper fixtures carrying hardened steel bushings for guiding the tools, the first fixture drilling out the end of the rod after which the whole thing is pulled over to the second position for finishing and a new fixture, which has been previously loaded with work, is placed under the spindles for boring. These fixtures slide on tracks which are guarded by raised edges so as to direct the lubricant to the end of the table and from there back to the distributing pump. The table is near the floor so that it is an easy matter to lift fixtures out from under the finishing reamers while the rod which has just been bored is slid over to the position for the second operation.

Grinding In the Valves

The valves are ground in under the small machine illustrated in Fig. 11, which turns the grinding spindle first in one direction and then the other by means of the partial wheel at the back operating on the small pinion beneath. More or less pressure can be put on the valve being ground by the handle shown above, which also serves to raise it from the seat whenever desired. The cylinder is easily moved under the grinding spindle on the flat table beneath.

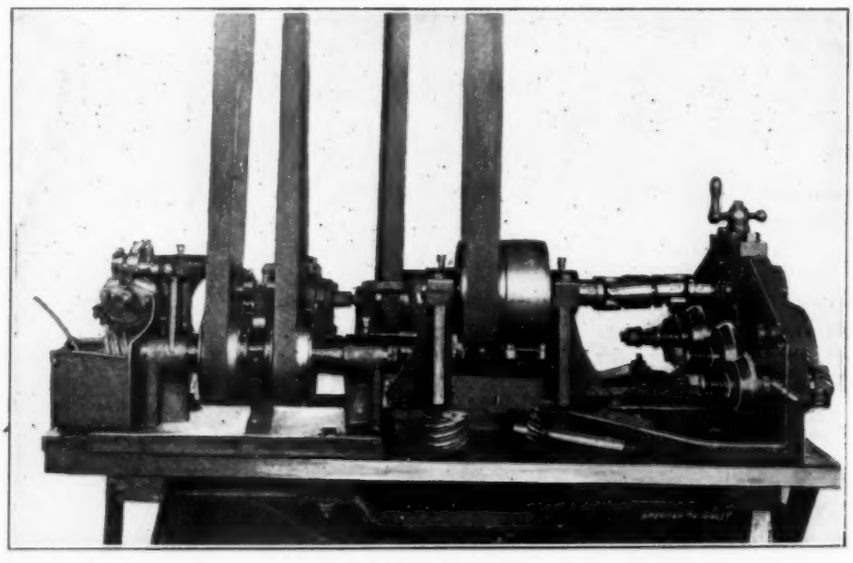


Fig. 7. Lapping Gears and Steering Worms

Grinding the Sides of Hardened Steel Rolls

A somewhat unusual use of the Heald piston-ring grinder is shown in Fig. 12, where a number of small hardened rolls

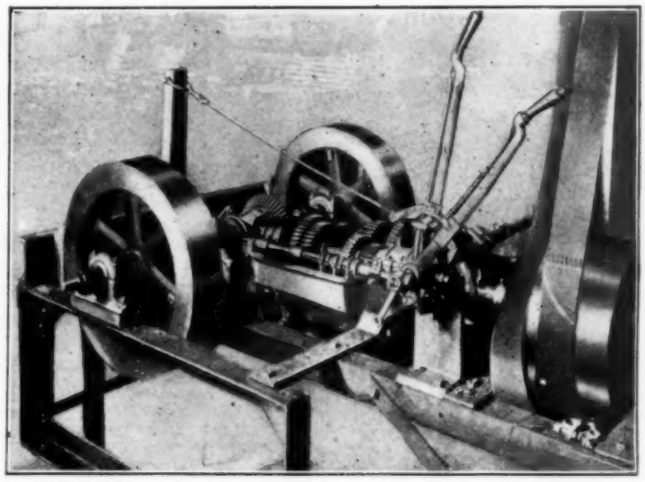


FIG. 5. TESTING TRANSMISSIONS

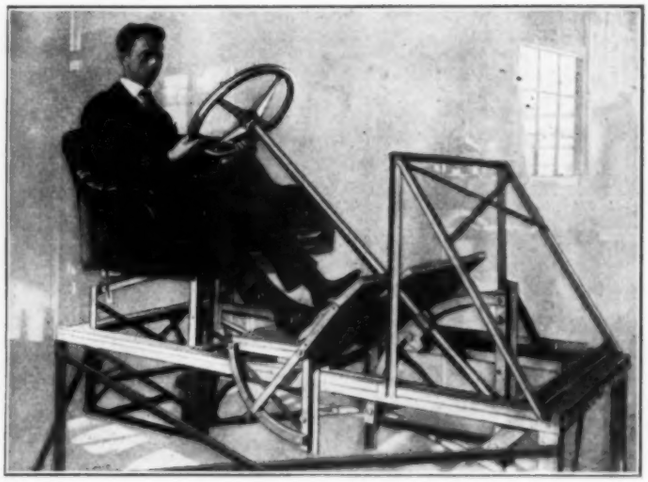


FIG. 6. FITTING THE AUTOMOBILE TO THE MAN

which are used in the ends of the valve-stem guides, are being ground to an exact thickness. A piston ring is placed on the chuck and the rolls put in circles around on the inside where they are held by the magnetic chuck and are ground in much the same way as piston rings or similar work.

A CROSS FACING TOOL

Fig. 13 shows a Potter & Johnston lathe at work on a gear blank, which is finished all over. Special jaws are provided as shown, but the most interesting part of the proposition is the facing tool shown in its working position and the way it is fed across the work. This consists of the holder *A* and the slide *B* which carries the tool *E*, shown in Fig. 14, and is controlled by the spring *D* around a stem connected with the slide. After this facing tool is swung into position, the back rest of the cross slide *C* is timed to move forward against the rod projecting from the tool slide and fed across the surface to be faced, the spring *D* resisting the feed and insuring steadiness to the tool as well as providing for its return after the cut has been made. There are many places where a tool of this kind can be used to advantage.

GRINDING PISTONS

Pistons are ground in an interesting manner on the special fixture shown in Fig. 17, which consists of an arbor *A*, having a substantial center hole at *F* and ready for the locking nut *B*. There is a hole through the head of *A* as indicated by the dotted lines, this hole being tapered from each end to allow free play for the pin *C* and having a guiding pin *E* projecting into this hole and fitting the slot *D* in the pin which goes through it. The recess in the pin at the left of *E* forms a bayonet joint, so that when the pin *C* has been put into place and turned slightly, this recess prevents it from dropping through and at the same time allows it to adjust itself freely in any direction. The upper end of the pin *C* has a T-slot, and the end of the wrench *G* can be inserted in this slot when a slight twisting motion hooks the lip *L* and allows the pin to be easily turned and withdrawn as desired.

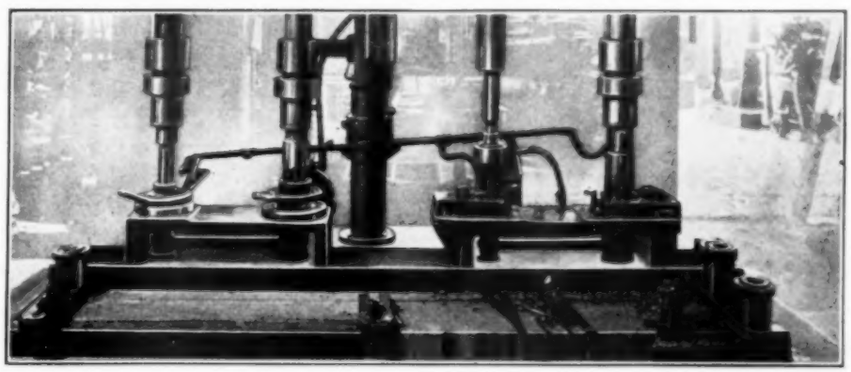


FIG. 10. BORING CONNECTING RODS

The piston *C* is slipped over the arbor *A* and against the follower plate *H*, which slides on a key in *A* and carries the driving arm shown. The pin *C* is then slipped through the wrist-pin holes of the piston by means of the wrench *G* and the piston tightened by screwing up the lock nut *B* against the plate *H*. It

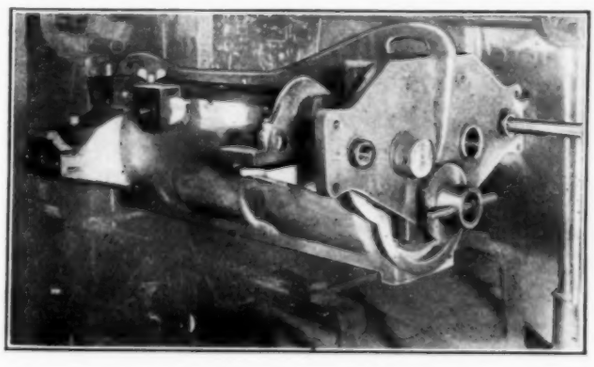


FIG. 8. HAND-REAMING FIXTURE

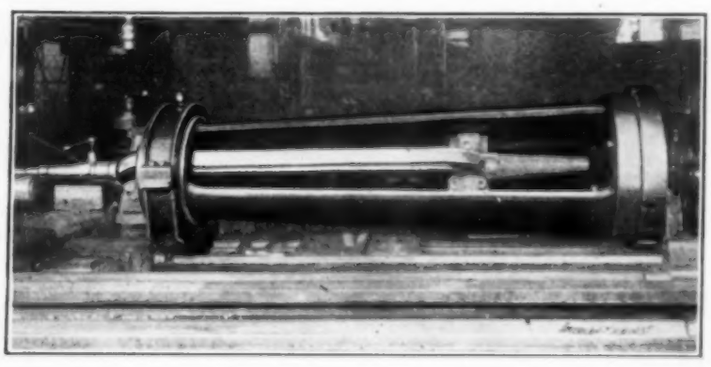


FIG. 9. TURNING BEARINGS OF SOLID AXLES

is then placed in the Norton grinder as in Fig. 18 and ground in the regular way.

Bending a Ring of Wire

A very simple bending fixture is shown in Fig. 15 where a base plate *A* carries a stud *B* having the upper end turned small and a corresponding groove down near the plate to form bearings and guides for the bending handle *C*. This in turn carries a roll *D* having a groove of the proper radius for the wire to be bent. The end of the wire is inserted in

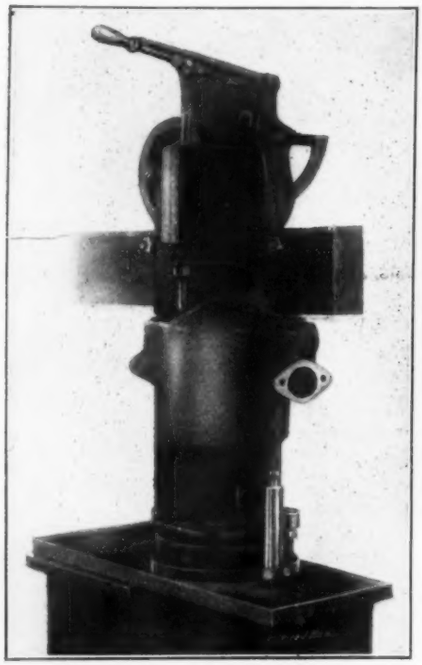


Fig. 11. Grinding In Valves

the hole *C* near the center of the stud and in line with the groove on the roll *D*. It will be readily seen how a single revolution of the handle *C* will roll the wire around the stud and produce the ring *F* as shown under the handle.

An Indicating Inspection Gage

A novel use of the indicating gage is shown in Fig. 16. This is a measuring stand with an adjustable table and fitted with an Ames micrometer gage. It is used in the inspection department for a

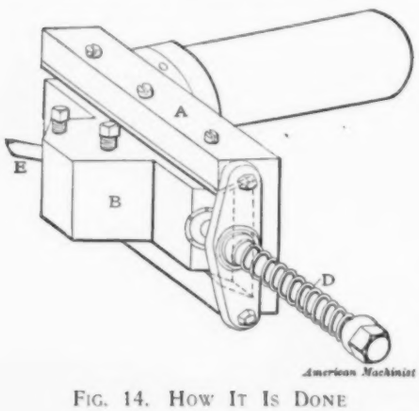


Fig. 14. How It Is Done

Fig. 12. Grinding Small Hardened Rolls

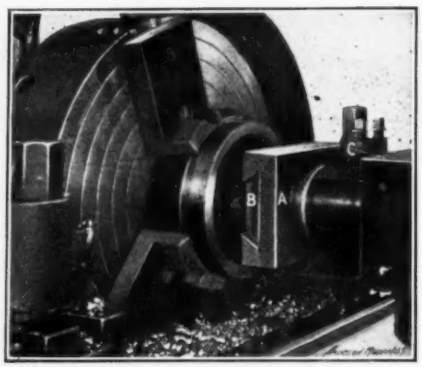


Fig. 13. Cross-facing Tool

large variety of work such as the pins shown. The gage is set to size by standard blocks and the pieces to be tested rolled on the table under the plunger as shown. This shows at a glance the exact variation if any, from the standard size, and enables the inspector to see whether this is within the acceptable limits of accuracy. It makes a rapid form

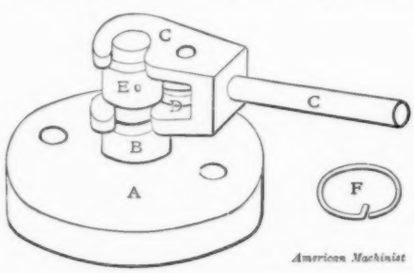


Fig. 15. Bending a Wire Ring

of indicating gage and can be used in many places to advantage.

Interesting Broaching Work

Superintendent of Production Buxton has developed the use of broaching to a larger extent than is used in almost any other factory we know of. Fig. 19 shows a few of the broaches and the work done, which gives some idea of the extent to which this work has been carried in this shop. The most interesting piece is the internal gear *A*, which has been broached in the coupling shown in front, and to the right of the clutch disk. This has 14 teeth, six-pitch, of the stub variety, the teeth being about ¾ inch wide on the face, in nickel steel. The two lower broaches are used for this particular work, each being about 4 feet long, or about equivalent to a continuous broach 8 feet in length. This requires a very careful proportioning of the teeth of the broach to avoid too heavy a cut being made at any one time and yet have each tooth do its share of the work. These

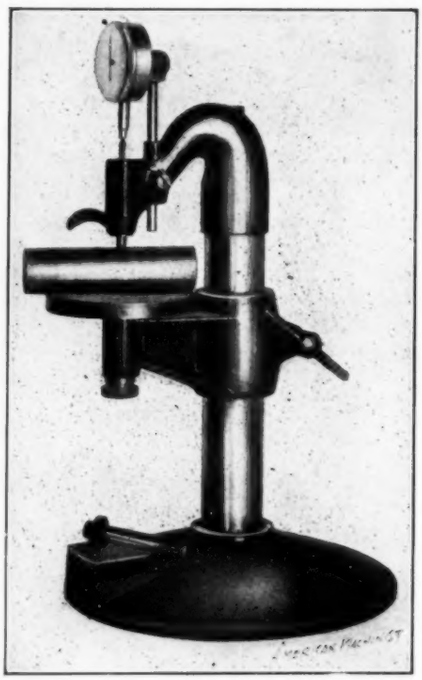


Fig. 16. Using a Dial Micrometer as an Inspection Gage

broaches are used on a No. 4 Lapointe broaching machine.

Drawing Tubing in a Broaching Press

Some of the tubing used is not drawn to the exact size wanted and the broaching machine is again called into play for this. At *A* and *B*, Fig. 20, are shown two of the arbors, the tube being slipped over one of these and against the enlarged

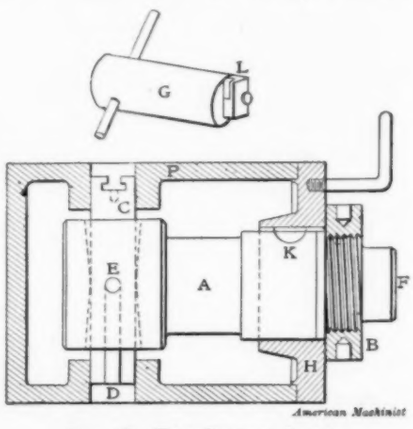


Fig. 17. The Piston Arbor

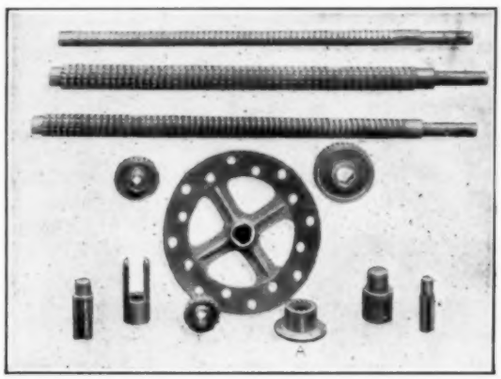


FIG. 19. BROACHES AND THEIR WORK

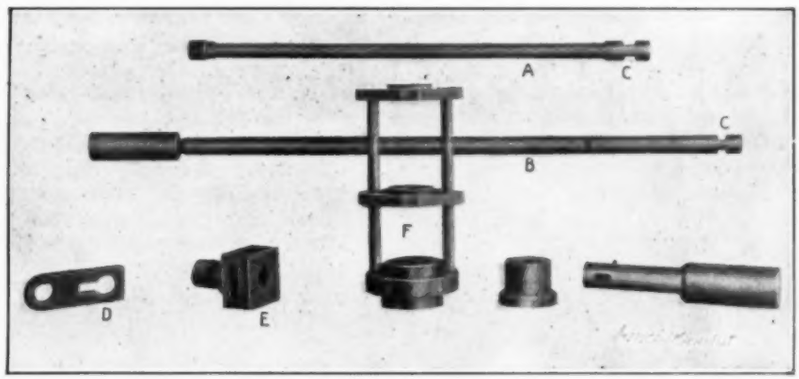


FIG. 20. DRAWING TUBING TO SIZE IN A BROACHING MACHINE

end which holds it for drawing. The slide *D* fits the slot in *E* and when raised presents a round hole so the arbors can be slipped into place, then *D* is pushed down so the slot engages the flats at *C* on the arbors, and the tube is ready to be drawn through the dies *F*. A large number of tubes are drawn in this way on the same machines as those which do the broaching.

CLEANING UP THE CYLINDER CASTINGS

Fig. 21 shows the operator in the sand-blast room where the cylinder castings are first cleaned when they first come from the foundry. The cylinders are behind the canvas curtain through which the hose is run, this being one of the arm-holes through which the operator

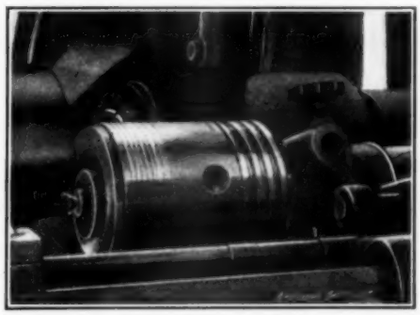


FIG. 18. GRINDING PISTONS

sticks his arms and directs the sand-blast as he looks through the celluloid window above. It will also be noticed that he is provided with a substantial hood and that a flexible hose runs through this which is connected to a low-pressure air supply, keeping the hood free from particles of dust which might be injurious to him. It goes without saying that when a man must work under such conditions, which are sometimes necessary, he should be provided with the best appliances known to remove as many objections as possible and prevent injury of any kind.

Fig. 22 shows how a portable electric motor and a walrus-hide wheel are used in cleaning up the outside of the cylinder castings, to improve their appearance and make them more agreeable to handle. The spring suspension and the handles at the back and sides make it very easily controlled. F. H. C.

FIG. 21. SAND BLAST IN USE

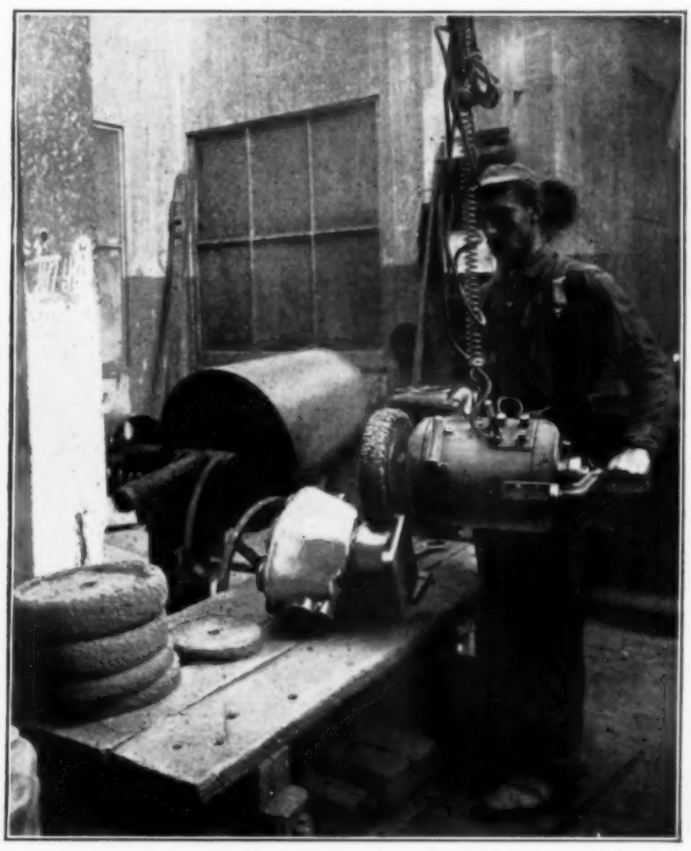


FIG. 22. PORTABLE GRINDER IN USE

A Swiss Fine Measuring Machine

By Dr. Alfred Gradenwitz

The measuring machine constructed by the Société Genevoise pour la Construction d' Instruments de Physique et de Mécanique, Geneva, Switzerland, is designed for measuring a length of four meters, its main feature being that the accuracy of readings is affected in no way by any deformation of the bench. This machine is illustrated by Figs. 1 and 2.

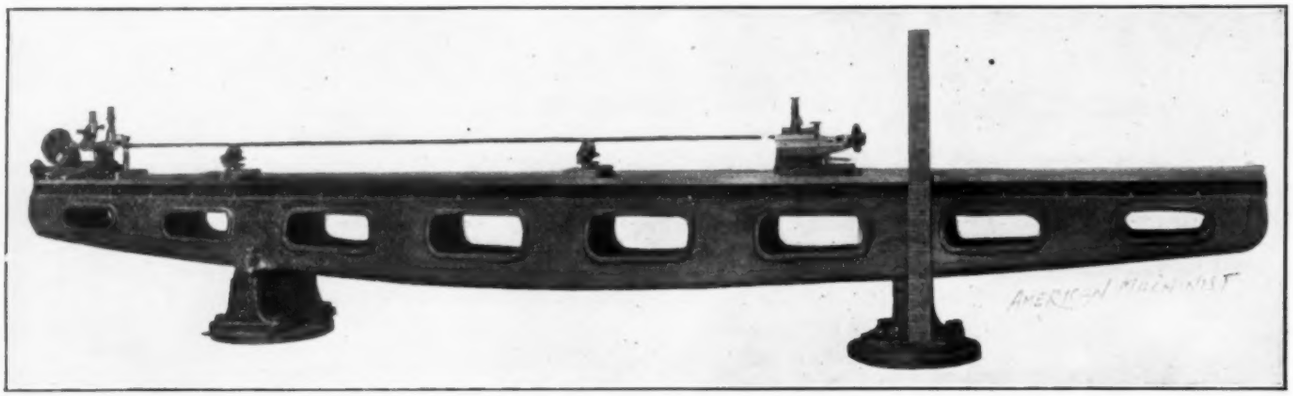


FIG. 1. SWISS MEASURING MACHINE

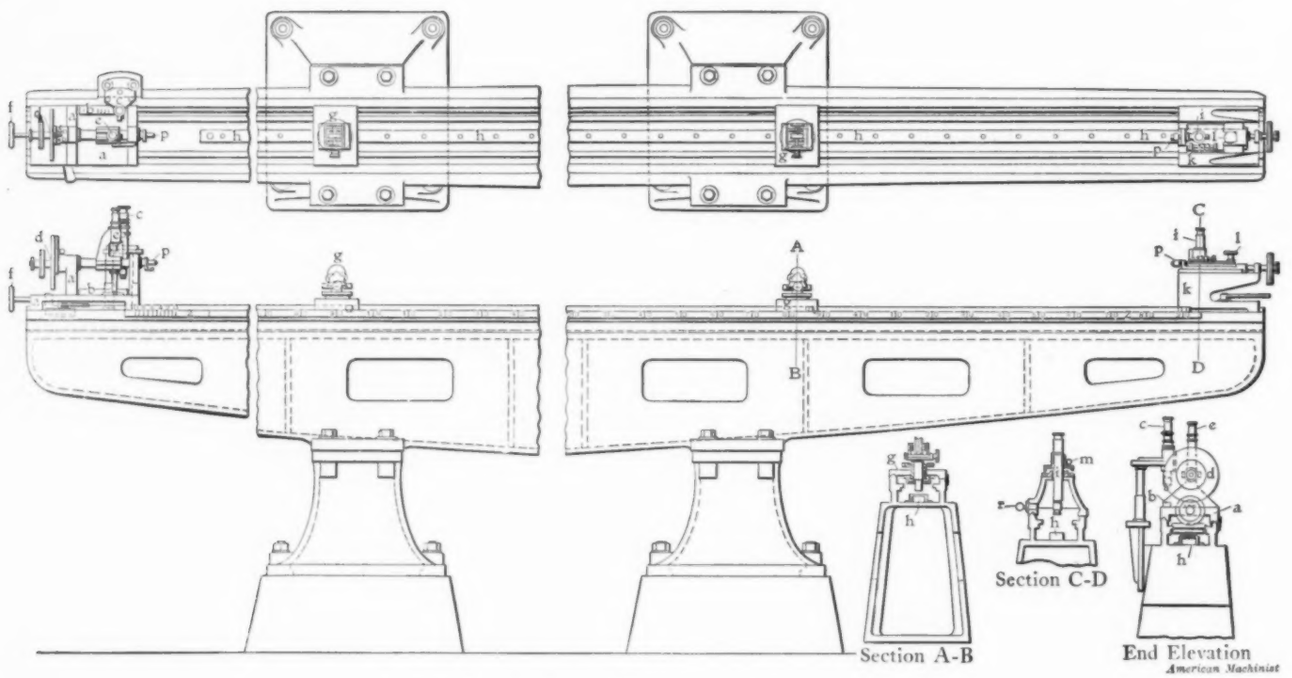


FIG. 2. SWISS MEASURING MACHINE

The reading microscope *i*, Fig. 2, is provided with an attachment for re-establishing its vertical position with any position of the sliding-block *k* on the bed. In fact, the microscope carries an extremely sensitive level, each division of which corresponds to one second, while a differential spring arrangement allows of infinitely small angular displacements of the microscope.

As seen from the plan of the machine, the microscope *i* is situated in the axis of the measuring line as determined by the two contact points *p p* between which the objects to be measured are located. In this manner is avoided any disturbing influence due to defective setting in the horizontal plane.

THE SCALES AND MICROMETER

The cast-iron frame carries a steel scale *h* of rectangular cross-section which is provided at distances of 1 decimeter apart with a lining of non-oxidizable nickel steel on which an exceedingly fine graduation is marked. This line is fixed by the microscope *i* by means of a pair of cross-wires. The sliding head *a* carries in its turn a small scale *b*, 1 decimeter in length, divided into millimeters, which is placed below the microscope *c*. Thus the whole decimeters are measured with the scale *h* and the microscope *i* the centimeters and millimeters with the scale *b*, and fractions of millimeters (down to thousandths of a millimeter) with a micrometer drum *d*.

The micrometer *d* is provided with a purely optical contact-checking device. In fact, the contact point *p* carries a graduation which is fixed by the microscope *e;* the contact point *p* is constantly pushed forward by a spiral spring, and when its line is viewed in the microscope the pres-

sure will be constant, the length of the object being given by the distance between the end of the contact point *p* and the resting point of the micrometer screw.

The Supports

The ways further carry supports *g* adjustable in a vertical and horizontal direction, allowing the work to be centered on the machine; in order to eliminate friction where gages are measured on these supports, the latter are provided with a double set of idlers.

In the photographic view shown in Fig. 1, the machine is represented on an improvised base. After being delivered to the Machine Works of Fives-Lille, the cast-iron pillars of the machine were placed on a concrete foundation.

In order to give an idea of the accuracy which is obtained by the machine, it may be said that the maximum error found in testing the machine previous to its delivery was found to be 7/1000 of a millimeter in a length of four meters, which is surely working to close limits.

Reminiscences of Fifty Years as an All-round Mechanic

Experiences in All Kinds of Shops with All Kinds of Work

By John J. Grant

Looking back on more than fifty years of my active life in the machine shops of America, with many ups and downs, I have thought some of my experiences would be worth the reading by men and boys in the same walk of life.

I shall in the future stick to my text—interesting things I have been up against in machine shops—but for a starter a word or two of a personal nature.

I was born in Leicester, England, on March 22, 1844, and came to America in 1848. They tell me I came from a mechanical family. It must have been mechanical as it could not have been a financial one for I have never heard of a rich Grant.

Book Learning Hard Work

On arriving in America the school ma'ams commenced the arduous task of my education, or rather tried to cram book knowledge into my head, and from the various thrashings I can remember having received, it must have been uphill work.

If there was any job of tinkering in the little old red school house at the parting of roads, where I got what book knowledge I received, I was the one to do it. Early in the game I was given up as a bad job in the literary line. I am sure of this as I was graduated without a diploma tied with blue ribbons and was placed at work in a woolen mill at an early age, working only 13 hours a day. I can now look back with some amusement at attempts I made at the early age of 11 or 12 years, to revolutionize the manufacture of woolen cloth.

My good old father let my inventive ability have full scope if I did not neglect my work. Only once can I remember his getting out of patience with me. That was when I attempted to take off the electricity from the finishing cards caused by the rub rolls; and not being an Edison, not only failed but came near smashing things generally, including myself. He took me by the ear and said there was altogether too much mechanic in me and that I had better attend to my work.

My First Machine Job

My first job in a machine shop was cutting, straightening, flattening and punching lead wire used for weights in Jacquard looms and a prouder boy never lived. Of course, I had several fights with the other boys because I felt my oats. One of these fights especially fierce was with Christie Baush, father of the Baush boys of boring-mill fame.

I got a little insight in machine work by helping the machinist who did the general machine work around the factory. I had never seen a steam engine to remember it, and the mechanical germs having commenced to work I sought knowledge of steam engineering of the engineer with but little success, for he had never learned the trade and knew nothing about the construction of a steam engine. But he was sure there was a cylinder, piston, and a flywheel and that the piston went back and forth. So with that knowledge I started in to make an engine, which at that time was the hight of every boy's ambition that was mechanically inclined.

I succeeded after many failures, one of which was to get rid of the steam in the cylinder caused by there being no way for it to escape, as the D-valve had no exhaust chamber or the cylinder exhaust ports, but one day I discovered the trouble, made the necessary changes and the next time I tried to start it, it must have made 2,000,000 revolutions per minute as I remember now after these many years.

Of course, nearly every one in the small village came to see my engine and from that day I was a second Watt and all the other celebrated mechanics that any of the villagers had ever read of.

Roller Skates and Clocks

My next attempt was a pair of roller skates made on account of my father forbidding me to skate on the ice. I had good success with them and was supposed to have been the original inventor of roller skates until someone several years after, in an article in the American Machinist, proved there had been a priority of invention dating back to about the year 1600.

I had done considerable clock tinkering and got the fever of clock making and made a complete grandfather's clock, movement, dial, and case, and had it running before I was 13 years old. I would give many dollars if I had that clock and steam engine at present, but when I went to learn my trade, or rather when I had been at it long enough to know more than the superintendent, I took them apart to refinish them, with the usual results in such cases, and they were never assembled again.

The next thing was marine engineering. I made a boat about 12 feet long and put paddle wheels in it, but one night the rain descended and the floods came, it broke loose from its mooring and went over the dam, and that was the end of my ambition to become a second Robert Fulton.

An Offer from George H. Corliss

The turning point in my life was when an oil merchant, Mr. Reisner, came into the factory and saw my steam engine running, taking steam from the heating pipes. This gentlemen told my father that I would certainly make a second Corliss and that I must get started at once to learn my trade; he lived in Providence and was well acquainted with Corliss. In a short time I received an invitation to visit him at his home. I was then nearing the advanced age of 14 years and it was a great day for me when I started, with a hundred instructions from the whole family of how to conduct myself, including one from my dear old mother not to whittle and make things around the house without clearing up afterward. I set off for Providence, my first trip away from home. If ever a boy had as good a time

as I did on that visit I have never heard of it.

I was taken down to the Corliss shop and introduced to the men in the high places as the coming mechanic of the age, which I think my benefactor really believed. I was immediately accepted as an apprentice and indentures were drawn up and signed by me for a seven-year apprenticeship; four years in the machine shop and three years in the drafting room. I went home to have my hopes dashed to the ground by the refusal of my father to sign the papers. He said he had served seven years' apprenticeship and I should never do it. He wrote to Mr. Reisner to that effect and in a short time I received word that he had secured me a place at Brown & Sharpe's for a three years' term.

Brown & Sharpe's Old Shop

How well I remember the day I went with my father to Brown & Sharpe's shop at 115 South Main Street, Providence. Here I met Mr. Sharpe, who questioned me and also read the riot act to me. And Mr. Brown took me under his wing and said, "you look like a good boy."

Well, boys, you who have served your apprenticeship in the old shop and know what it was to scrub the sink so that it would satisfy Mr. Sharpe and have had Mr. Brown stand by you and encourage you when you made a slip or a bad job, know what it was to be brought up in a shop where boys were *instructed;* it would be far better if there were more of such shops at the present day.

Of course, the kind of work that was done at that time in Brown & Sharpe's was not the kind that made the all-around machinist but it laid the foundation for it. The country job shop was the place where you could take a post-graduate course that would fit you to repair a sewing machine in the morning and in the afternoon put a soft patch on a boiler, lying on your back in a hot firebox. But at Brown & Sharpe's you got it pretty thoroughly drilled into you that *quality* and not quantity was the first requisite in a good mechanic.

I would like to know if any of the boys of that time remember the sound of the bell that used to call us down to the front shop to get a lecture from Mr. Sharpe for some infraction of the shop rules, and then perhaps to meet Mr. Brown on the stairs when going back and have him try to talk severe to you, about the shop being a school for the boys. And then, because he thought he had hurt your feelings, hand you out a 3- or 4-inch scale that he would explain was a little damaged—I could never see the damaged place.

Well both of them have gone and certainly have left their "footprints on the sands of time" and a name that stands high for all that is good in mechanics. That was a great combination—a disciplinarian and an easy boss—and the result is the men and mechanics turned out are favorably known all over the world.

This is not going to be an autobiography, but an account of shop experiences and in my next article, I'll "get on the job" to the best of my ability.

Oxygen, Hydrogen and Nitrogen in Steel

By E. F. Lake

Of all the elements that enter into the composition of the earth's crust oxygen forms nearly one-half, or, to be more explicit, 47.29 per cent. At the higher temperatures it has a greater or a lesser affinity for and unites with every other elemental substance known, except fluorine, helium, neon, argon, krypton and xenos, and it acts readily upon a large number of compounds. At the ordinary temperatures oxygen does not act readily upon most other things. Its simple compounds are called oxides, and these form with the production of heat. One of the elements that combine with it at low temperatures is iron, and this is coated with an oxide when heated to about 400 degrees Fahrenheit, or at nearly any temperature in the presence of moisture. Iron does not occur in nature except in combination with oxygen, and occasionally other elements are found combined with these.

Hydrogen is the lightest substance known, and like oxygen is a gas that is colorless, tasteless and odorless. It has a high chemical affinity for oxygen and is a good reducing agent that acts by taking the oxygen away from substances. It has a great affinity for carbon and forms something like 200 combinations of hydrocarbon. When iron is heated to a red heat it easily penetrates this and forms into a compound.

Nitrogen, owing to its inactivity, serves principally as a diluent of oxygen.

These three gases readily dissolve in iron or steel when it is molten but as it solidifies come out of the state of solution, and then much the larger part passes away. A portion, however, is usually entrapped, and this portion if segregated in large bodies causes blow-holes gas bubbles, etc. Carbon monoxide gas (CO) which may be generated during the solidification period by a reaction of the oxide of iron with the carbon when carburizing, is also a cause of blow-holes. These blow-holes are usually removed by the use of the deoxidizers, such as manganese, silicon, aluminum, etc. Another portion of these gases, however, is liable to form microscopic bubbles that are difficult to remove from the metal, and consequently they form the occluded gases and oxides that are just beginning to be recognized as among the most harmful things in steel; oxygen probably being the most weakening element that can be left in steel, with hydrogen and nitrogen closely following.

As evidence of this, bessemer steel, which is purified by blowing air through it, is the poorest and weakest of steel, while open-hearth steel, which is purified without this blast of air but is not protected from the air striking the surface of the bath, comes next; and crucible steel being protected from air by the melting process taking place in a closed pot, is the strongest and finest grained of all the steels, except those made in the electric furnace, and this is also protected from the air. Another proof is the added static and dynamic properties, wearing qualities, etc., that are given to steels, by such elements as vanadium, titanium, etc., when they are used to cleanse the metal of these gases.

Oxide occurs in very small black specks throughout the metal and can only be seen when the surface has been perfectly polished and magnified at least one thousand times. They are invariably found in steels that produce blisters when pickling, and this leads to the conclusion that the blisters were formed by the reduction of oxide by the nascent hydrogen evolved during the pickling process. High-carbon steel rods that contain the same impurity occasionally fracture in the pickling bath and doubtless the same pressure that blows a blister in mild steel will cause a rupture in hard steel.

Owing to the gaseous nature of oxygen, and the fact that the drillings must be very fine, it is difficult to analyze steel for the oxygen content. A series of tests, however, was carried out by E. F. Law, of London, by cutting a piece from each of eleven bars of acid and basic bessemer steel that contained from 0.10 to 0.18 per cent. of carbon, and only a trace of silicon. Each piece was then rolled into 24 sheets which were pickled and annealed by the usual process. An adjacent piece of the bar was analyzed, examined with a microscope and the oxygen determined. The result of these tests are shown in table.

An examination of the table will show that as the oxygen content increases the number of blistered sheets increased, while the percentage of sulphur seemed to have no effect on the blistering; the set containing 19 blistered sheets only showing 0.071 per cent. of sulphur, while the set of sheets that did not blister at all contained 0.076, 0.069 and 0.061 per cent. of sulphur respectively. By way of com-

parison a piece of basic bessemer steel was analyzed just before the ferro-manganese was added, and this showed 0.062 per cent. of oxygen. The results shown here seem to forcibly confirm the oxide theory.

It might appear at first sight that the quantities present are extremely small, but in making comparisons we should not consider alone the amount of the elements present but also the combination of these elements that influence the quality of the steel. Thus, we speak of 0.05 per cent. of sulphur, when in reality it is 0.13 per cent, of manganese sulphide that affects the quality of the steel. Oxygen has only half the atomic weight of sulphur and is capable of forming larger quantities of compounds, therefore, it exerts a greater influence. Thus, where 0.05 per cent. of sulphur corresponds to 0.13 per cent. of manganese sulphide, 0.05 of oxygen corresponds to 0.22 per cent. of ferrous acid.

Another fact brought out in these tests is that the amount of oxide visible under the microscope was much less than would be expected from the amount actually found by chemical analysis, and this might be accounted for by the fact that a considerable quantity of oxide was in solution in the steel surrounding the black oxide spots. The oxide showing on the surface of a polished piece was also reduced by the aid of hydrogen and an electric current, and the pit thus formed occupied a much larger area than the spots of oxide seen by the microscope.

Steels containing oxides also apparently rust much quicker than those free from them and with two pieces placed side by side the oxide steel will show rusting long before the other, while in dilute acid solutions steels containing oxide corrode more easily and much faster

Kind of Bessemer Steel.	Analysis. S.	P.	Mn.	Microscopical Appearance.	Sheets in 24 That Blistered.	Percentage of Oxygen.
Acid	0.061	0.049	0.340	very good	0	0.021
Basic	0.069	0.034	0.385	good	0	0.021
Acid	0.076	0.070	0.350	good	0	0.022
Basic	0.101	0.126	0.475	fair	4	0.025
Basic	0.080	0.066	0.430	moderate	6	0.026
Acid	0.106	0.188	0.320	bad	7	0.026
Basic	0.079	0.098	0.440	bad	7	0.027
Basic	0.045	0.075	0.473	bad	8	0.034
Acid	0.061	0.081	0.350	bad	9	0.032
Basic	0.080	0.068	0.450	bad	12	0.030
Basic	0.071	0.090	0.480	very bad	19	0.046

TABLE SHOWING EFFECT OF OXYGEN ON BLISTERING.

than those free from oxides. This has led to the production of a steel as free from oxides, as well as other impurities, as it is possible to make it commercially and this has been named "Ingot Iron." A typical analysis shows it to contain 0.02 per cent. of carbon, with the manganese 0.01 per cent., sulphur 0.02 per cent.; oxygen, 0.03 per cent. and phosphorus and silicon a trace. Its strength and ductility are almost identical with wrought iron and it is as easily weldable.

In manufacturing this metal the old idea, that it was necessary to use ferro-manganese for a deoxidizer and to make the metal workable in a hot condition was abandoned and ferro-silicon, or other materials, are used to remove the oxides from the bath. The difficulties encountered were a blistering of the metal and a cracking of the edges when rolling into sheet but it was found that when the oxygen was reduced to a comparatively small percentage these faults did not occur. This adds more evidence to the oxide theory and helps to prove that oxygen is the cause of hot-shortness.

Ingot iron is made in basic-lined open-hearth furnaces that are charged with pig iron low in silicon and sulphur and the phosphorus content slightly above that limited for bessemer working. With this is charged open-hearth mill scrap and low-carbon steel turnings. When a sufficient quantity of mill scale is obtainable this is substituted for ore in the charge. An active basic slag that is produced by limestone and fluorspar is used. The boiling is continued for about 10 hours to an excessive degree to thoroughly oxidize the impurities, and as the metal purifies the temperature is raised very high (over 3000 degrees Fahrenheit) owing to the higher melting point of the purer metal. This makes it necessary to use a comparatively large amount of fluorspar to prevent the phosphorus from returning to the metal.

It has been found that the oxygen can be reduced in percentage by various materials. Ferro-silicon is the most used in the furnace because it is a very active agent but pig iron in itself is very good. Ore or mill scale is also used to help oxidation but the larger part is oxidized and absorbed, as usual, by the basic slag. What little remains at the time of tapping can be still further removed by adding in the ladle such materials as aluminum, ferro-vanadium, ferro-titanium, etc.

Convenient Assembling Stands for Gas Engine Work

ASSEMBLY STANDS FOR AUTOMOBILE ENGINES

The illustration shows a very convenient form of assembly stand used in the shop of the Davis Manufacturing Company, Milwaukee, Wis. The box-shaped frames are supported on trunnions at each end and the engine base is bolted to it; then the cylinders are mounted and the whole thing turned over so that the pistons, connecting rods and crank shafts can easily be put in place and adjusted. The whole engine can be tipped to any desired angle and affords easy access to all parts of the engine. When completed they are handled on the truck shown in the foreground.

To draw the temper on small steel parts put them in hot emery, is the recommendation of an English contemporary. It distributes the heat evenly, is much cleaner than lead, and safe to handle. It conforms to all irregular-shaped work, and assures an even temper.

Special Tools and Methods Used in a Planer Building Shop

Processes and Devices Used to Advantage in an Ingenious Manner

Editorial Correspondence

The Cincinnati Planer Company employs in its shops at Cincinnati, Ohio, a good many special tools and interesting methods, one of which is illustrated in the halftone Fig. 1. This shows a special boring fixture as used under a Cincinnati-Bickford 5-foot radial drill in boring the holes through the sides of a planer bed for the bearings of the gear shafts.

The Boring Fixture and Its Work

The planer bed shown under the drill is for a 30x30 inch machine and is 14 feet long. It is for a three-shaft planer and there are three sets of bearings in the fixture for guiding the bar and locating the holes the correct distances apart. The bar is connected with the driving spindle by universal joint, its alinement being maintained by the bearings in the fixture. The latter is provided with V's corresponding with the planer ways and when clamped in place against the planer bed tissue paper 0.001 inch thick is placed at four points at each side of the fixture, between the V's of the fixture and work showing that the fixture is properly secured when all of the eight pieces of paper are pinched tightly between the bearing surfaces.

The Boring Bar and Cutters

The same boring bar is used for the three pairs of holes in the opposite walls of the bed and in each operation two cutters are carried in the bar for boring the opposite holes simultaneously. The cutters are round in section, are double-ended and made of high-speed steel. Three cuts are taken through each hole. The first pair of cutters used in the bar bore to within 1/16 inch of size; the second pair enlarge the holes to within 0.005 of size; the third set finish the holes to size without being followed by a reamer.

In changing the boring bar for the next pair of holes the positions of the cutters are changed as the distance between the ends of the bearing poles to be bored through the bed is greater in the case of the intermediate and bull-wheel shaft bearings than for the bearings first bored, this bringing the two cutters in the bar further apart than in boring the first pair of holes.

The sketch Fig. 2 shows the bar with several cutter holes and holes for taper pins for locating the cutters. In order that there shall be no confusion in changing the cutters to the right distance apart the holes at the lower end of the bar are smaller than those at the top and cutters of different size steel are used. Also the holes for the taper locating pins are staggered at either side of the center line making it impossible to locate a cutter in the wrong hole.

Cutting Gears

The gears on the Cincinnati planers are finished with what is known as a "single-purpose" cutter, which is a cutter with tooth form developed especially to suit the gear which it is to finish. The teeth are roughed with high-speed cutters and in one case noticed a forged blank of 30-point carbon steel was being cut 2-diametral-pitch with the cutter running at a surface speed of 55 feet per minute and feeding at the rate of 0.002 inch per tooth of cutter. A liberal quantity of lubricant was of course supplied to the cutter and work. This job was a bull pinion 10½ inches long and the cutter advancing at the rate of 1-1/16 inches per minute required only a little over nine minutes to each tooth. This roughing cut was taken with a No. 1 involute cutter and about 1/32 inch stock was left for finishing with the "single purpose" cutter.

An interesting point in connection with this operation is the fact that when the same cutter was run at a peripheral speed of 40 feet it did not stand up but required frequent regrinding until the speed was advanced to the 55 feet noted above,

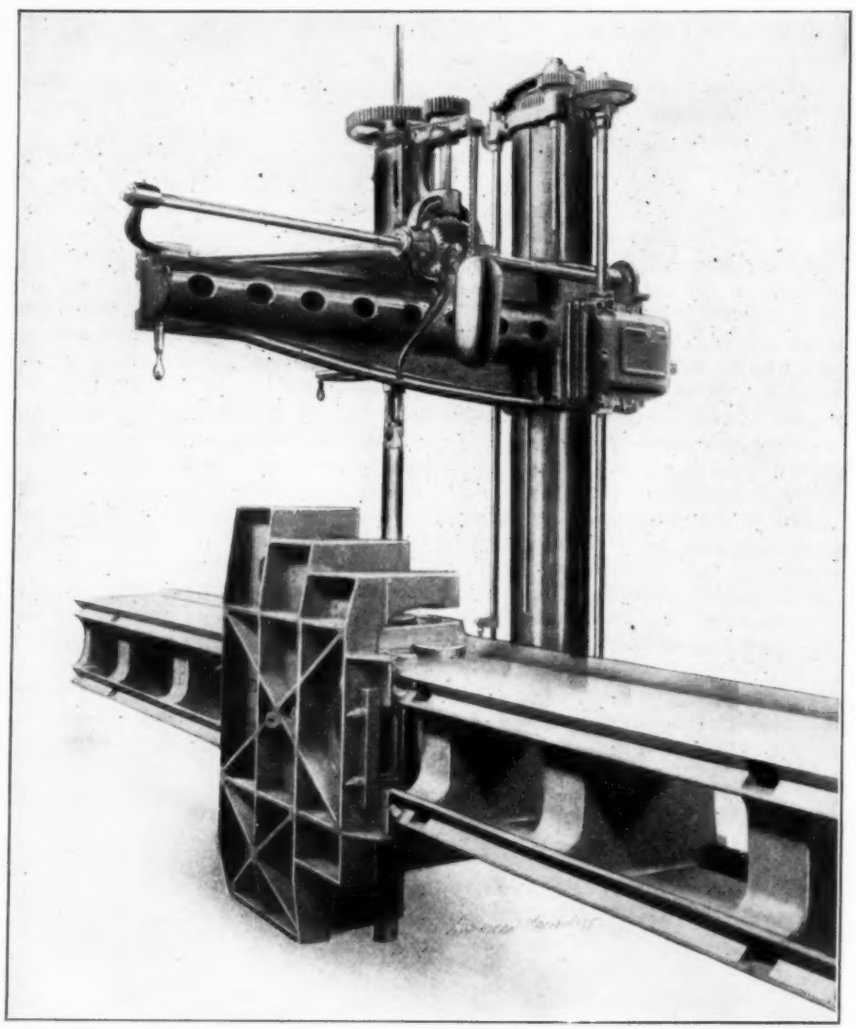


Fig. 1. Boring Holes for Gear-shaft Bearings in Cincinnati Planer Bed

an increase of practically 30 per cent., there being then no further trouble with the cutter corners breaking down.

Feed Device for Planer Side Head

An ingenious device for operating the vertical feed of the side head on the Cincinnati planer is illustrated by Figs. 3 and 4. This head is fed on the upright by means of a nut revolving about the stationary vertical screw shown at *a* Fig. 3, just behind the rail, the nut being rotated

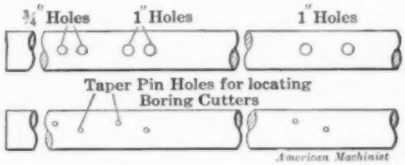


Fig. 2. Cutter Bar for Planer Bed-boring Fixture

by mechanism operated by the same vertical rack *b* as actuates the heads on the cross-rail. The device which controls the feed for the side head is so constructed that the feed for that head may be varied from the maximum down to 1/128 inch per stroke regardless of the rate of feed given the heads on the cross-rail; that is, the latter may be given a feed, of say, one inch and the side head at the same time a feed of 1/128 inch, if desired.

The feed rack in its up and down movement actuates a pinion *A* Fig. 4, and a shaft *B* upon which is keyed a disk-shaped member *C* having on its inner end a series of sharp-edge 90-degree clutch teeth adapted to be engaged by similar teeth upon the inner end of another member *D*, Figs. 3 and 4, placed upon the outer end of *B*. Upon the inner hubs of *C* and *D* is freely mounted gear *E*

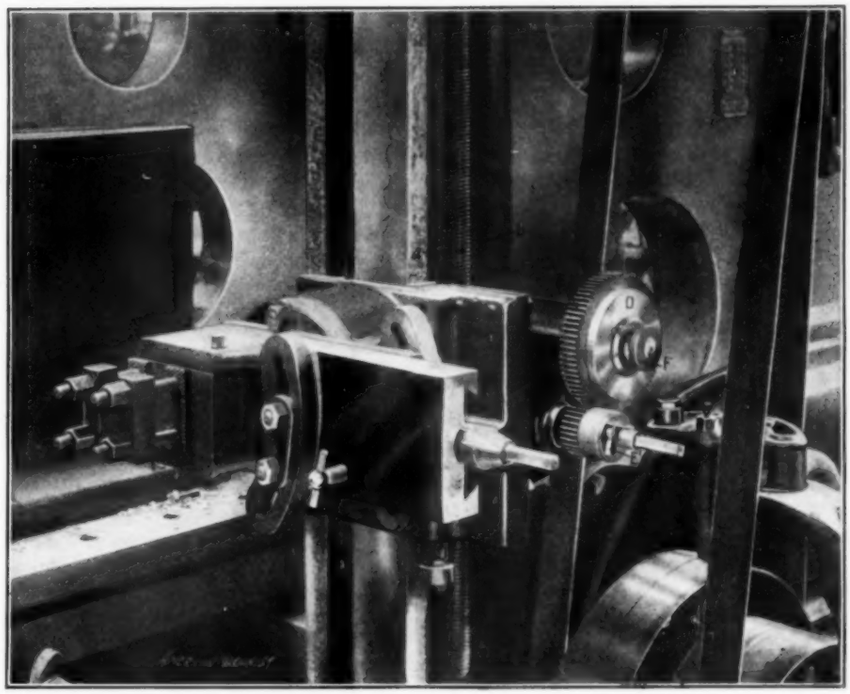


Fig. 3. Side-head Feed Mechanism on Cincinnati Planer

which operates the pinion and pawl *E'* (Fig. 3) for rotating the gears that operate the feed nut on the vertical screw behind the head. It is obvious that as gear *E* is rotated back and forth upon its bearing the distance through which it is turned will determine the amount of feed imparted to the side head and that variation in the rotary movement of *E* will vary the rate of feed accordingly.

Adjustment and Operation

Upon examining the sectional views of the assembled device in Fig. 4, showing the general scheme, it will be seen that disk *C* carries a pin 1 adapted to engage the end of a pin 2 passing through gear *E*, the other end of which engages pin 3 secured in disk *D*. The two disks *C* and *D*, owing to the clutch teeth formed on their hub faces as already noted, may be so adjusted relatively to each other by removing nut *F* and withdrawing *D* from engagement with *C* as to bring the three pins in contact as shown in the upper section in Fig. 4. In this position the entire rotary movement imparted to *C* by the feed rack will also be given to

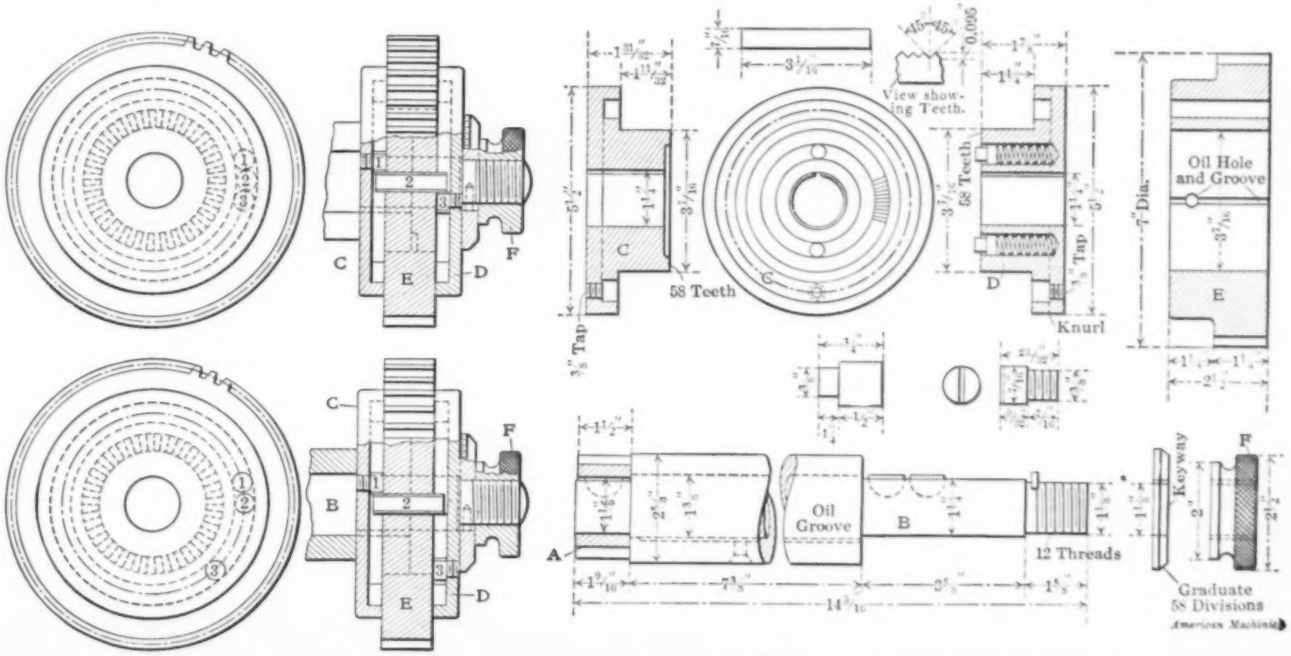


Fig. 4. General Arrangement and Details of Side-head Feed for Planer

gear *E* as the latter is positively connected between *C* and *D*. By withdrawing *D* from *C*, turning it upon its bearing and resetting its teeth again in engagement with the teeth on *C*, as in the lower view in Fig. 4, it is clear, that, owing to the clearance between the pins, gear *E* will not be turned back and forth through the same angular distance as is covered by disks *C* and *D*.

Assuming, for example, that disk *C* turns toward the observer, gear *E* will be carried with it, but on the return stroke the pin 3 in *D* will not contact with pin 2 until the gap between pins 2 and 3 has been covered, thus leaving gear *E* idle for a certain portion of the movement. The further that disk *D* is adjusted around to carry pin 3 away from pin 2 the greater will be the leeway between the driving pins and hence the smaller the movement of the gear and the finer the feed rate imparted to the side head.

A few details are presented in Fig. 4 to make the construction clear. In the assembled views the parts are shown in slightly different form than in the details as they are reproduced here merely to illustrate the general scheme of construction and operation.

The device carries two arrow heads facing in opposite directions with the words "More" to the right and "Less" to the left, indicating the direction in which *D* is adjusted to increase or decrease the rate of feed.

A Loose Pulley Bushing

The method adopted by this company to avoid loose-pulley troubles is shown by Fig. 5, which illustrates a phosphor-bronze bushing as fitted in all of their loose pulleys. This bushing is flanged at the ends which are turned to fit tightly in the bore of the pulley while the body of the bushing between the finished flanges is approximately of elliptical form. This leaves a large oil space around the body of the bushing which is nearly closed along the two high edges approaching quite closely to the full diameter of the finished ends. Slots are cored at *a* and *b* from opposite ends and a little past the middle so as to overlap one another and felt is placed in the two slots so that as the pulley rotates and the oil is thrown up toward the outside of the chamber between the bush body and the pulley bore it is carried against the felt and led down to the bore of the bushing and the shaft upon which it rotates. This provides an effectual means of lubrication. Oil holes are drilled in opposite ends of the pulley hub leading down to the chamber around the bronze bushing and these are closed with oil covers. The bushing, while fitted nicely in place, is further secured by a headless screw tapped half in the bushing and half in the pulley hub.

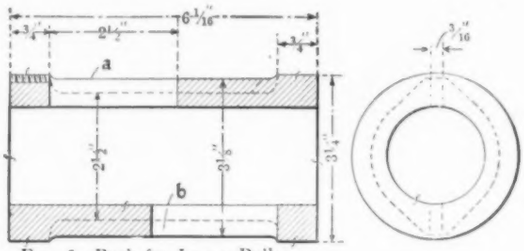


FIG. 5. Bush for Loose Pulleys.

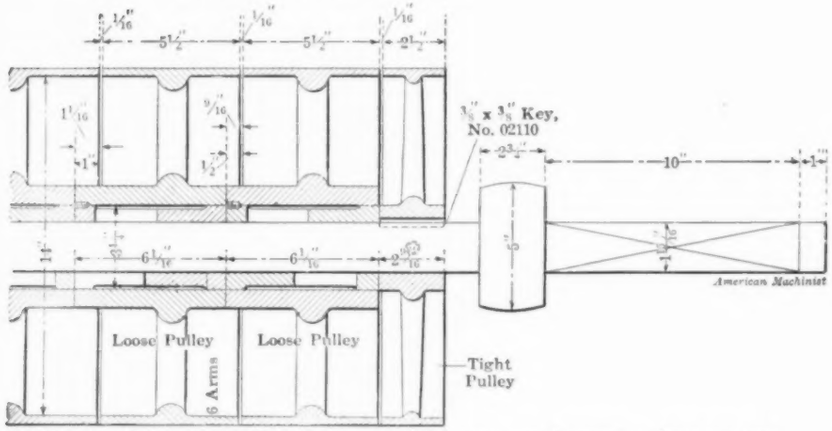


FIG. 6. PORTION OF THREE-SPEED COUNTERSHAFT SHOWING APPLICATION OF LOOSE PULLEY BUSHINGS

Fig. 6 illustrates an interesting application of this loose-pulley scheme to a special 3-speed countershaft on which six pulleys with this bush are used; the planing speeds derived from this counter being 20, 33 and 50 feet per minute and the return speed 80 feet per minute.

Machining Phosphor Bronze Bushings

Bushings of the type just described are turned, faced and bored in an engine lathe equipped with a turret on the shears. The latter is provided with two boring bars carrying respectively roughing and finishing cutters. The end of the bar during the boring operation is rigidly supported in a long bushing in the spindle. The cutters are flat, double-end tools of high-speed steel. The roughing cutter leaves 1/32 inch for finishing, the hole cored through the bronze casting being about 3/16 inch under size. The cutter in the second bar is made very slightly above size, 0.001 inch or a little more, depending on the size of bushing, and after this cutter has been run through and the bushing has cooled off a hand reamer is put through and takes out about 0.00025 inch. While the finishing cutter is actually above standard size the expansion of the metal which takes place during the boring operation is sufficient to offset the oversize of the cutter and allow the hand reamer which is kept dead to size to scrap out the quarter-thousandth after the work has cooled off.

The boring is done at a speed of about 100 feet per minute and a very smooth hole is obtained in the work with the finishing cutter.

Costly Reaming

A workman was recently given the job of reaming (by hand) 40 one-inch holes through cast-iron flanges 2 inches thick, to bring the holes in each pair of flanges in line with each other. After the man had worked nearly a day, resting two minutes out of every five, the work being so hard, it was observed that the holes not having been drilled with sufficient accuracy of spacing, were out of line from 0.002 to 0.125, consequently, reaming with a straight reamer where there was 0.0625 inch to cut, was pretty slow work, especially when the depth of teeth on the end of the reamer was less than the 0.0625 inch.

The shop foreman had just been calling down the man for taking so much time at the job, when the workman induced the foreman to take a hand at the reamer in person. Less than two minutes settled it, and the workman was started post-haste for a 1-inch drill, which was to be sent through the hole and followed by the reamer. Fully one-half a day's time would have been saved had the foreman given him a drill with the reamer, or had he provided a suitable reamer for the purpose.

A reamer for this kind of work should be straight for about half its length, the shank and taper for the balance of the length. This permits the reamer to side-cut instead of bringing the holes into line by end-cutting and elbow-cutting for hour after hour. The shop foreman must be a tireless exponent of eternal and ceaseless vigilance if he expects to get along smoothly.

Unforseen Difficulties in Starting a Shop

By S. L. Platt

The foreman of a tool room had worked out an idea for gas engines, that he considered a great improvement. The company he worked for, when it was submitted to them, did not think it worth taking up. This was disappointing, and he tried several other gas-engine manufacturers, but fared little better. One company thought it a good thing in a way and were willing to take it up, but the arrangements they wanted to make for handling it were not satisfactory to the foreman.

Failing to interest others, he took the matter up with the head of the machine shop, who had been a staunch friend for many years. Together they planned and figured until there seemed no other way but to manufacture the engines themselves. Finding that their combined resources did not amount to enough to start in with, they interested several of their intimate friends, and finally succeeded in getting what they considered sufficient money to make it practical to form a company and manufacture the engines.

The Estimated Profits

Having the opportunity of studying the ways and methods of manufacturing engines in the plant of the company they were with, and getting price lists from the catalog, they thought they could see a wonderful profit. The castings, forgings, gears, fittings, etc., were not hard to calculate; the time for each part was easy to obtain; and knowing the rate of wages paid, the total was soon figured out. Adding a small amount for other expenses which they knew in a vague way, would have to be met, a margin was left which aroused them to enthusiasm over the prospects, and they entered into the manufacturing plan with a will.

Fitting Up the Shop

Familiarity with machine tools and their prices made it possible to estimate very closely on the outlay in that direction. Rent for the amount of space needed struck them as very unreasonable, but as much hunting did not relieve this situation, they finally settled on a place that could be made to suit their requirements, deciding to make up the loss in some other way.

When the machinery began to arrive, they discovered that freight and cartage items summed up to a figure considerably beyond their expectations and estimates. Another thing proved quite a surprise, also—the amount of the bills for small tools, drills, files, hammers, screws, nuts, bolts, emery cloth, belts, fasteners, and a number of other things that had always been so common around machine shops. It had never occurred to them what these things amounted to, when bought in quantities (sufficient to get a discount below the retail single or dozen prices).

Though somewhat dismayed, they were not disheartened at these things, and kept cheerfully going ahead, feeling that it was only a little while before they could enjoy the profits the business would yield.

Up to this time they had been so busy arranging the shop, getting the machines placed, having patterns made, looking after castings, drop forgings, etc., etc., that they had given little attention to other things, but as all these matters were fast getting completed, it become evident that they must do something toward looking after the selling end.

Quite a few engines were sold by their friends and themselves right in their own city, specially low prices being made on account of friendship and good feeling, thus giving a few orders to start on.

Getting Up a Catalog

The next thing they considered was a catalog, for "you can't do much until you have a picture and description to show a man," the foreman said. The interview they had with the printer was another eye opener. One engine had been made, and from this a photograph was taken, but as they had concluded to make some slight changes, it meant altering the print. Other changes were necessary to conform to the larger size that they had decided to make, and the cost of getting out the cuts under these circumstances staggered them. Consultation with several different printers did not give them much choice. The catalogs themselves, for they wanted to pattern after the ones gotten out by the concern they had been with, cost a great deal more than they had imagined. They had seen them used and sent out from the office with a liberality that did not indicate that they were worth very much. But as they must have them, the order was given. The slight difference between two, three or five thousand, seemed so small that they took the larger number to have that agony over with for some time to come.

Finance as a Factor

Things were about ready to start off with a bang, so one evening was devoted to getting their books and accounts into shape to see just how they stood. This was another shock to them, for they made the discovery that if they paid up all the bills they owed, it would wipe out their bank account, and take quite a little besides. Going over the various items, they noted where their estimates were short, but even though they had known each one at the time, they had not realized that the aggregate would amount to so much. This is where they made their great mistake. Instead of going to their stockholders and putting the matter before them and getting more money, their pride held them back, thinking it would be a reflection on themselves; so they determined to hold off the payment of the bills and use the money for running expenses. It was but a little while before they began to feel the cramped condition of their finances. The money for the few engines they sold to their friends, did not come in very fast. Probably all the time they wanted to make the payments was one of the conditions due to friendship, in their minds.

Getting into the Trade

When it came to disposing of their output they found all the responsible dealers handling one make or another, and not inclined to change unless very favorable concessions were made in price, deliveries guaranteed, and certain advertising done to help the sales. These were new conditions to be dealt with; nor had they made any arrangements to meet them. Even the discounts the dealers told them were allowed by other manufacturers were much larger than they had figured on.

While facing the condition of their finances, they had not done any advertising to speak of, and the call for their catalogs was so small that their value in bringing in business was almost nothing.

One of them had tried to do a little selling in nearby places, where he could go and return the same day, to avoid hotel bills. He secured a few orders, mostly at reduced prices to get the business.

Danger Signals

The money they had held back from the payment of bills was about gone, creditors were beginning to get after them for settlements, there were not enough orders on hand to hold out any prospect of pulling through. The engines that had been sold, being made one at a time instead of in lots, had cost them all of, if not more than the selling price. Rumors had gotten around of their condition, the stockholders heard them and began asking some rather pointed questions. Finally a meeting was called and a rather lively affair it was, as most of the investors were without much business experience, having put in their savings on account of the stories of the wonderful profit in gas engines. The meeting broke up with nothing accomplished other than a number of disgruntled stockholders,

who, with their usual freedom of speech, advertised the conditions of affairs pretty generally.

An overdue bill having been put in the hands of an attorney for collection, made it necessary for them to consult their own lawyer, who had heard some of the rumors, and by careful questioning, got the whole story. They were only too glad to unburden themselves to anyone who would give them a sympathetic ear.

Taking Another Tack

The lawyer, realizing the honesty of the two men, and feeling sorry at the prospect of their losing their savings, put his shoulder to the wheel, had an examination made of the books, concluded there was a chance for them to make good with a little more money and a business man to guide things. He succeeded in getting a man with some money interested. With this addition to their force, and the prestige it gave them, more money was secured and the business, after the time necessary to straighten things out, began to go ahead, and is today a live, going concern.

It is not always that good luck like this follows the starting out of men who think because they know the cost of material and labor and the selling price in the catalog, that the difference is all profit. Going in on this basis has brought many a concern to the wall. Many a mechanic in the shop thinks the owner is making money hand over fist, when in reality, he is not making both ends meet.

This is well known to those men in the shop who had at some time or another been in business for themselves. Such men appreciate the owner's position.

Plug and Templet Gage Dimensions

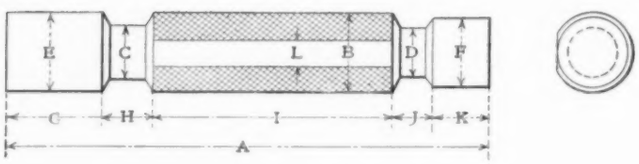
By C. H. Gray

Having been called upon to outline some sizes for plug and templet thread-gage blanks and thinking the results may possibly be of interest to others, I present them herewith. Fig. 1 shows the plug-gage blank and gives a table of sizes to which they can be made and carried in stock. The end *E* is turned oversize enough to allow for grinding after the plug is hardened, and the end *F* is turned to as large a size as possible as shown in the table, thus permitting the use of the blank for fine threads, and as this end is finished to represent the core diameter of the thread it will be seen that quite an allowance must be made in making up the blanks.

Fig. 2 shows the templet and gives a table of sizes. As shown in the sketch *E* is a reamed hole for a 3/16-inch pin which must be a good snug fit and the adjusting screws in this case are 3/16—32 U. S. The hole for the thread is left blank until the gages are finished. Tool steel is used for both plugs and templets and after threading, burring and stamping such marks as are necessary, they are pack-hardened, this, when properly done overcoming any tendency of the work to change more than can be corrected by the finishing operations.

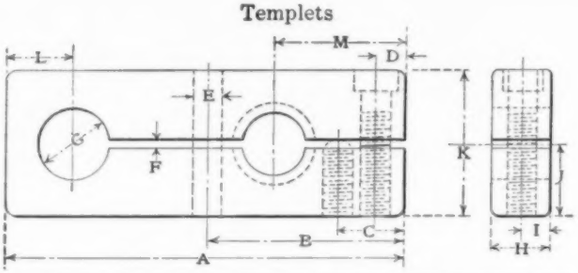
The utility of jewels in a watch, which are necessary in order to keep down the wear that would result from metal bearings, will be appreciated when it is realized that the five points in the "escapement" (the parts you see moving in the watch) make 432,000 motions every twenty-four hours. This means over 3,000,000 motions a week.

Plug Gage Blanks



Size	A	B	C	D	E	F	G	H	I	J	K	L
1/4	2 5/8	5/16	11/64	5/32	0.26	0.24	7/16	3/16	1 1/2	3/16	1/4	3/16
5/16	2 11/16	11/32	7/32	3/16	0.32	0.30	1/2	"	1 9/16	"	"	"
3/8	2 3/4	3/8	15/64	15/64	0.38	0.36	17/32	1/4	1 17/32	"	9/32	"
7/16	3	13/32	19/64	17/64	0.48	0.40	9/16	5/16	1 9/16	1/4	11/32	"
1/2	3 1/8	15/32	11/32	5/16	0.51	0.48	5/8	"	"	"	3/8	"
9/16	3 1/4	17/32	25/64	29/64	0.57	0.54	11/16	"	"	"	7/16	"
5/8	3 3/8	19/32	7/16	13/32	0.63	0.60	3/4	"	"	5/16	15/32	"
11/16	3 1/2	21/32	1/2	15/32	0.70	0.67	13/32	"	"	"	1/2	"
3/4	3 9/16	23/32	17/32	1/2	0.76	0.73	7/8	"	"	"	17/32	1/4
13/16	"	"	"	"	0.82	0.76	"	"	"	"	"	"
7/8	3 7/8	13/16	21/32	5/8	0.88	0.85	1	5/16	1 9/16	11/32	5/8	"
15/16	"	"	"	"	0.95	0.90	"	"	"	"	"	"
1	4 1/8	15/16	23/32	11/16	1.10	0.95	1 1/8	3/8	"	"	23/32	"

Templets



Size	A	B	C	D	E	F	G	H	I	J	K	L	M
1/4	2	1	3/8	3/16	3/16	0.05	3/8	5/16	5/32	13/32	13/16	3/8	11/16
5/16	2 1/16	1 1/16	"	"	"	"	"	"	"	"	"	"	23/32
3/8	2 5/16	1 1/8	"	"	"	"	13/32	3/8	3/16	"	"	25/64	3/4
7/16	2 7/16	1 3/16	7/16	"	"	"	"	"	"	15/32	15/16	"	13/16
1/2	2 5/16	1 1/4	"	"	"	"	7/16	"	"	"	"	13/32	27/32
9/16	2 11/16	1 5/16	"	7/32	"	"	"	7/16	7/32	17/32	1 1/16	"	7/8
5/8	2 13/16	1 3/8	"	"	"	"	"	"	"	"	"	"	29/32
11/16	"	"	"	"	"	"	"	"	"	"	"	"	"
3/4	2 15/16	1 1/2	"	"	"	0.06	1/2	1/2	1/4	19/32	1 3/16	7/16	31/32
13/16	"	"	"	"	"	"	"	"	"	"	"	"	"
7/8	3 1/4	1 5/8	"	"	"	0.07	9/16	5/8	5/16	23/32	1 7/16	15/32	1 1/32
15/16	"	"	"	"	"	"	"	"	"	"	"	"	"
1	3 5/16	1 3/4	"	"	"	"	"	"	"	25/32	1 9/16	"	1 3/32

American Machinist

FIG. 1 PLUG AND TEMPLET THREAD GAGE SIZES FIG. 2

Long Fixtures and Gang Cutters on the Miller

*By A. J. Baker**

In the two previous articles on milling, the operations described have been limited entirely to the production of plain surfaces. When a formed surface is desired, the use of end and face mills must be discontinued, and gangs of cutters should be employed. In such cases the traverse being in one direction only, there will be an idle return of the table. On modern machines, with quick table traverse, the major part of this idle time is made up of the starting and stopping of the spindle and feed, the movements of the operator, and overcoming the inertia of the table.

As all these elements are the same, whether 6 inches or 6 feet have to be traversed, it follows that a long jig carrying many pieces will be most economical in operation.

The long traverse has furthermore a better effect on the wearing of the table and saddle, largely preventing the local wear, that finally makes the table tight in one place and loose in another.

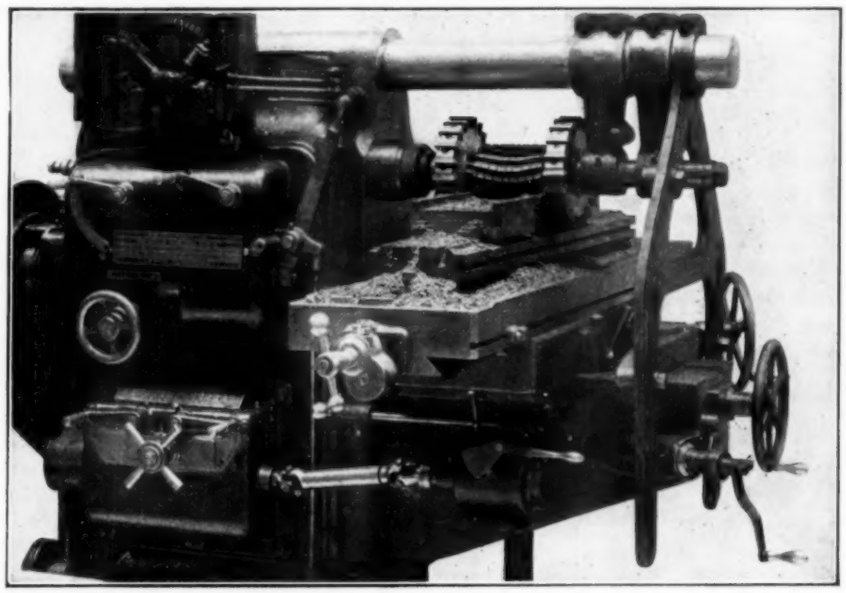


FIG. 1. ROUGH MILLING SIDES AND INNER FACES OF VISE HOUSINGS

MILLING VISE HOUSINGS WITH GANG CUTTERS

In Fig. 1 is shown a No. 4 Cincinnati high-power milling machine, roughing the sides and insides of No. 5 vise housings. These housings are previously milled on the top, leaving a projecting tongue strip which fits easily in the central slot of the fixture illustrated. The housings are cast with two lugs on each end, said lugs corresponding in location with the outside T-slots of the fixture. A bolt with a ball-end nut and washer acting on each lug secures the work to the fixture. These lugs are removed when the ends of the housings are milled and the locating tongue strip is also milled away, when the top of the housing is finished. The fixture and gang are shown in Figs. 2 and 3. Attention is called to the coarse teeth, large arbor, and special key. Under the heavy strains to which cutters are exposed in modern milling the standard key is far from satisfactory, and often gives much trouble, when it is desired to remove the cutter for grinding. The chip space, the radius at bottom of teeth, the comparatively acute angle, and the method of gashing the cutting edges are points which materially contribute to the life and easy cutting of the gang. In the example given here a speed of 21 revolutions per minute was used with a feed of 0.300 inch per revolution, giving a table traverse of 6 3/10 inches per minute. The total extent of the cut was 8½ inches horizontal, 8 inches vertical and 8¼ inches long. From ⅛ to 3/16 inch of metal was removed, and an entire lot of 120 pieces was milled without touching the cutter. In operation, the workman should follow up behind the cutter, removing finished, and replacing unfinished pieces. At the end of the stroke the last piece is left on the fixture, the brace and knee clamps released, the knee lowered sufficiently for the cutters to clear the work, the table brought back to starting position, the knee raised, clamped and the feed started. The remaining finished housing can then be removed.

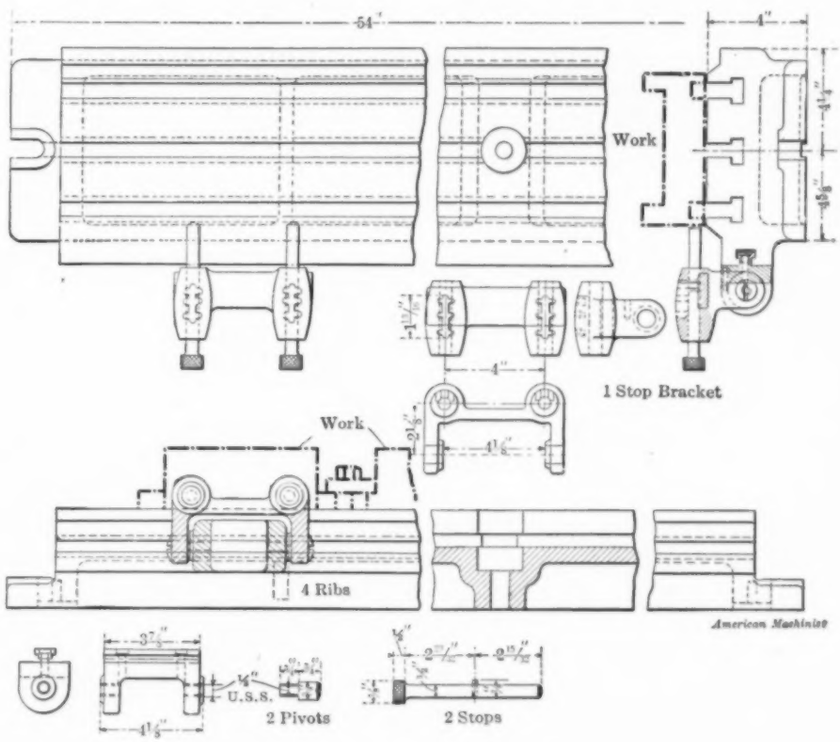


FIG. 2. FIXTURE FOR MILLING VISE HOUSINGS

ANOTHER ROUGHING OPERATION

In the last example, Fig. 4, a No. 5 Cincinnati high-power miller is shown roughing the inside of a vise body. The

*In charge jig- and tool-designing department, Cincinnati Milling Machine Company.

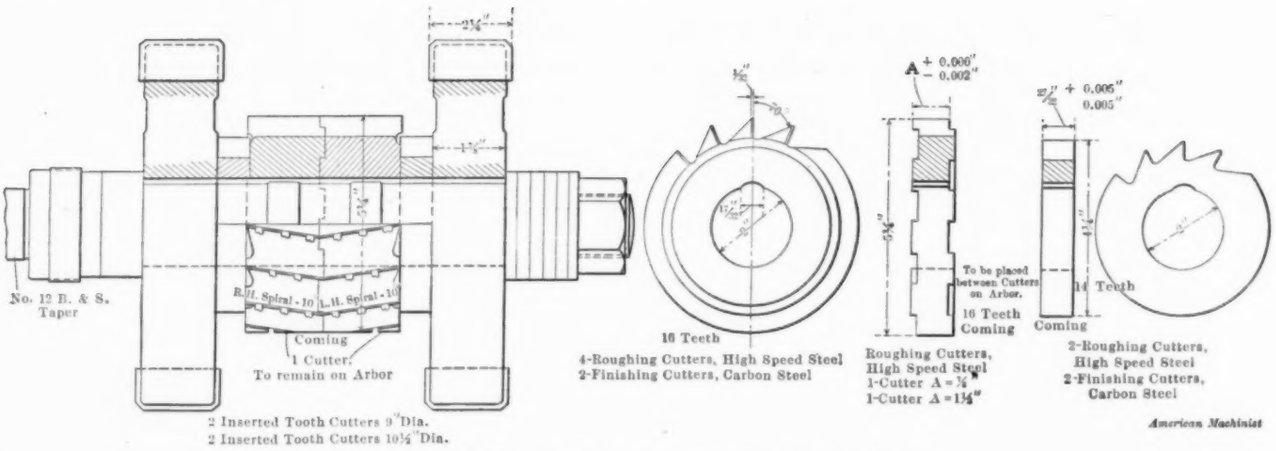


FIG. 3. GANG OF CUTTERS USED WITH FIXTURE SHOWN IN FIG. 2

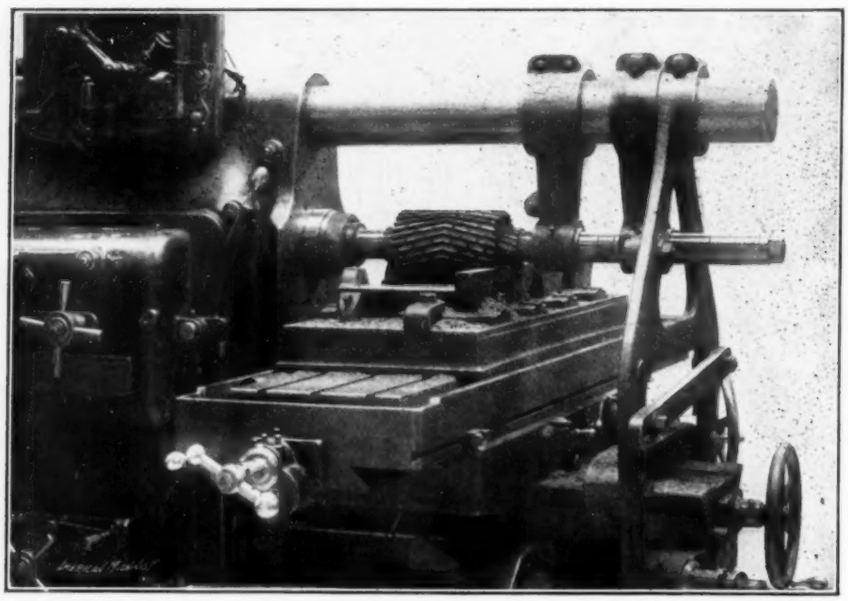


FIG. 4. ROUGHING INSIDE OF VISE BODIES

procedure in this case is similar to that described in the preceding case, but the job is a somewhat heavier one. The width of cut is 12 inches horizontal, 3 inches vertical, and the length is 6 inches. The cutters, 6 inches in diameter, run at a speed of 32 revolutions per minute, and the table feeds at 4¾ inches per minute. The fixture, shown in Fig. 5 consists of a cast-iron body with two end stops, one of which, *A*, has an inclined surface, which acts on the bottom flange of the work, and forces it down on the fixture. A plug with hardened steel pointed screw, and ordinary clamps are the means employed for holding the work.

The same gang may be used on all such work, for the finishing cut, by making the center cut with two interlocking cutters, and adjusting them apart to the proper dimension. This is good practice in any case where it is desired to keep to a standard size, and in addition it prevents the incurring of the expense of a second gang.

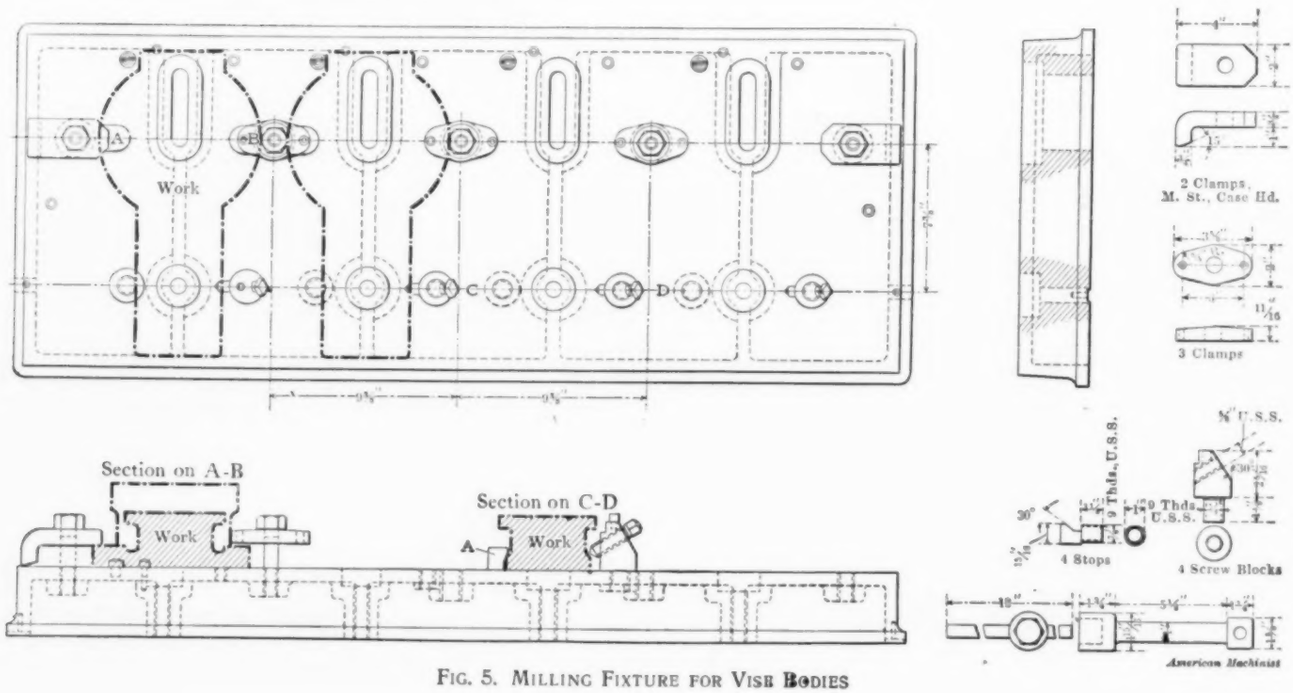


FIG. 5. MILLING FIXTURE FOR VISE BODIES

A Few Special Tools Used in Building Radial Drills

Various Fixtures and Devices Used in Some Interesting Operations

By F. A. Stanley

The halftones Figs. 1 and 2, illustrate a home-made horizontal drilling and boring machine used by the William E. Gang Company, of Cincinnati, Ohio, for boring holes in various castings used in the construction of their radial drills, and also for machining jigs and fixtures.

The machine has a long bed with a head consisting of a radial drill arm and head, the spindle of which is operated by a pulley at the end of the machine. The table, Fig. 2, may be adjusted along the bed to any required point, and it has a cross-feeding movement, also a micrometer head *A*, Figs. 2 and 5, attached at the side, which in connection with a series of size blocks, enables the table to be adjusted accurately for the spacing of holes. Another micrometer device *B*, Fig. 1, is used for facilitating the adjustment of the head vertically upon the column; thus center distances between holes spaced either horizontally or vertically are accurately obtained.

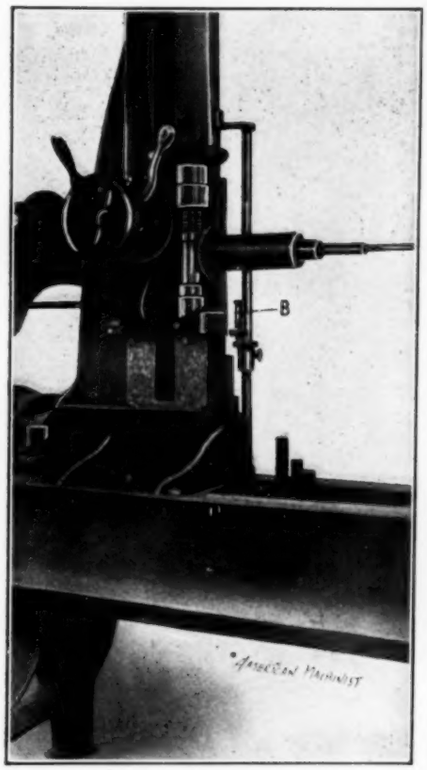


FIG. 1. HEAD OF SPECIAL HORIZONTAL DRILLING AND BORING MACHINE

The work table may be swiveled as required, and it is provided with a stop pin for locating it on quarters, that is, at 90-degree angles throughout the circle.

FIXTURE FOR FINISHING SPLINES IN SHAFTS

The radial drill built by this concern has a vertical driving shaft in the column which is splined to receive a feather by which it is connected with the hollow shaft forming the lower end of the driver; there is a similar spline in the horizontal shaft which drives the head spindle; also the spindle itself is splined for the driving feather. To finish these splines after they are roughed out by the milling cutter to about 0.002 or 0.003 inch of size, the fixture shown in Figs. 3, 4, 6 and 7 is used.

This device consists of a body of cylindrical form which may be attached to the cross slide of the lathe, and crosswise of which is bored a hole for a bushing which is a nice fit for the shaft to be finished. A cutting tool in the form of a square-nose planing or shaving cutter is mounted in the fixture in the manner shown in Fig. 6, and with the shaft placed between the lathe centers as in Figs. 3 and 4, the cutter is adjusted at the end of the work and the carriage traversed along the bed to shave the sides and bottom of the milled seat with the tool. The surfaces produced by this process are very smooth and the spline is accurately finished as to width and depth. The general arrangement of the fixture and the means of adjustment for the cutting

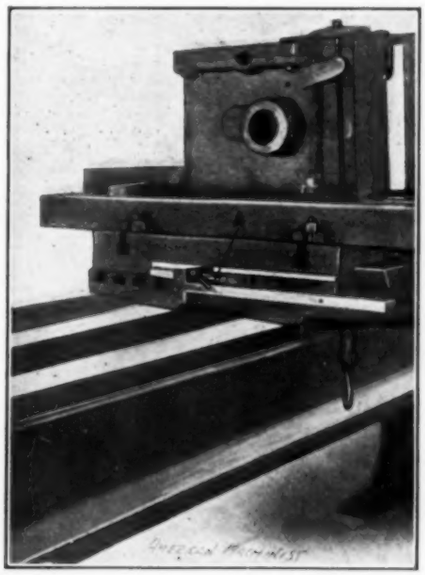
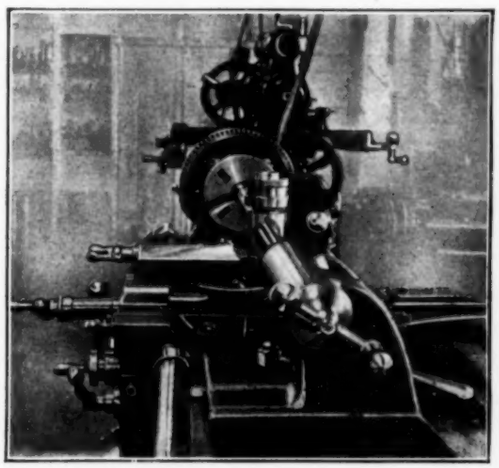


FIG. 2. TABLE OF HORIZONTAL BORING MACHINE SHOWING MICROMETER HEAD AND BLOCKS



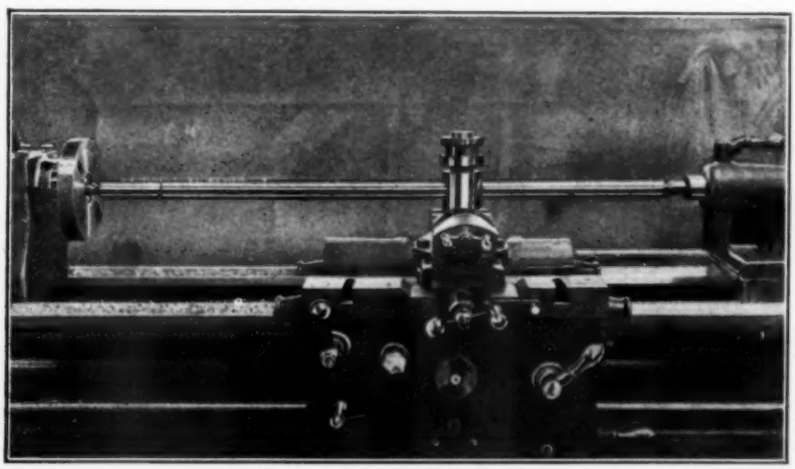


FIG. 3 SPLINE FINISHING FIXTURE IN THE LATHE FIG. 4

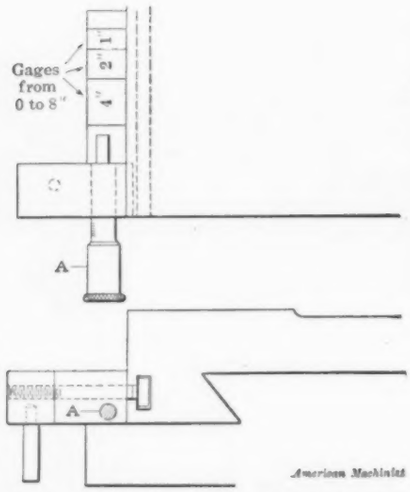


FIG. 5. MICROMETER ATTACHMENT FOR BORING MACHINE

tool will be understood readily from the sectional view in Fig. 6.

A SLOT FINISHING FIXTURE

The fixture illustrated by Figs. 8 to 11 is a simple vertical slotting device used in the milling machine for accurately finishing the slots which serve as seats for feathers in the hollow shafts referred to above, also in certain gear hubs, as illustrated in Figs. 8 and 10, the work, through which a milling cutter has been

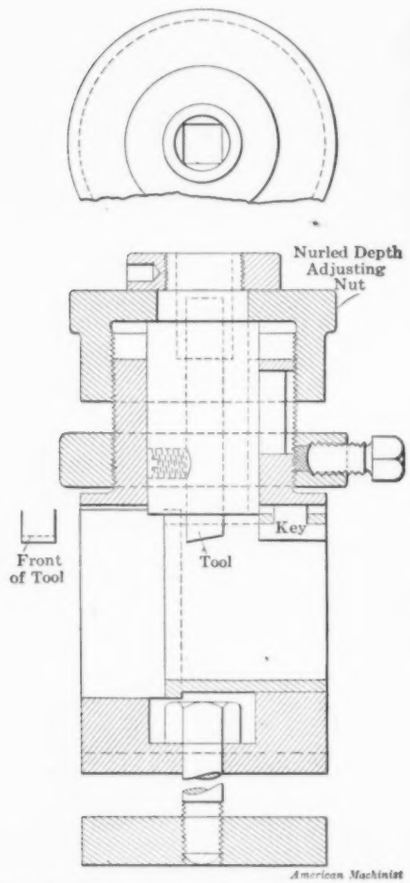


FIG. 6. FIXTURE FOR FINISHING SPLINES IN THE LATHE

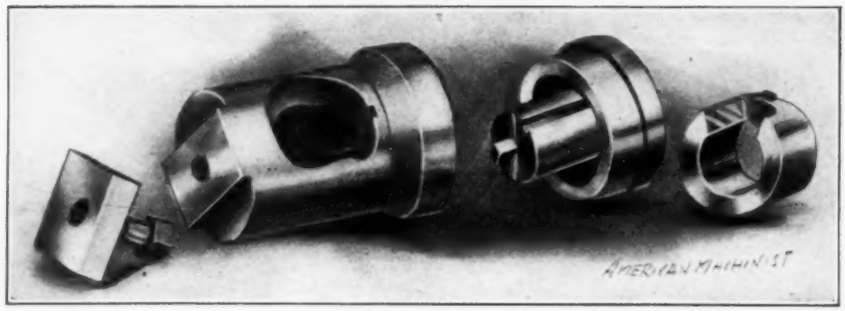


FIG. 7. SPLINE FINISHING FIXTURE PARTS

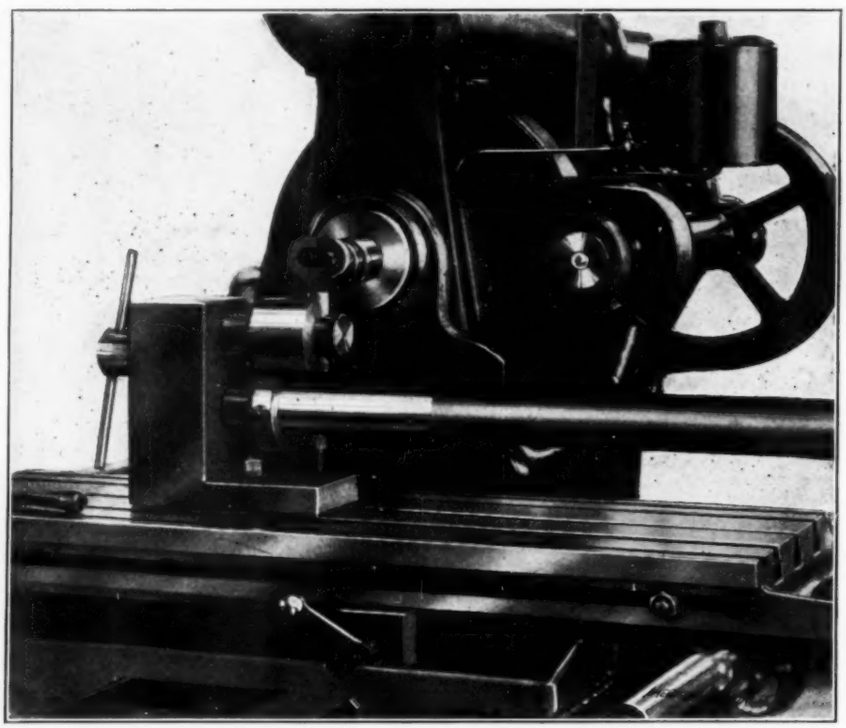


FIG. 8. CUTTING A KEYSLOT IN A HOLLOW SHAFT

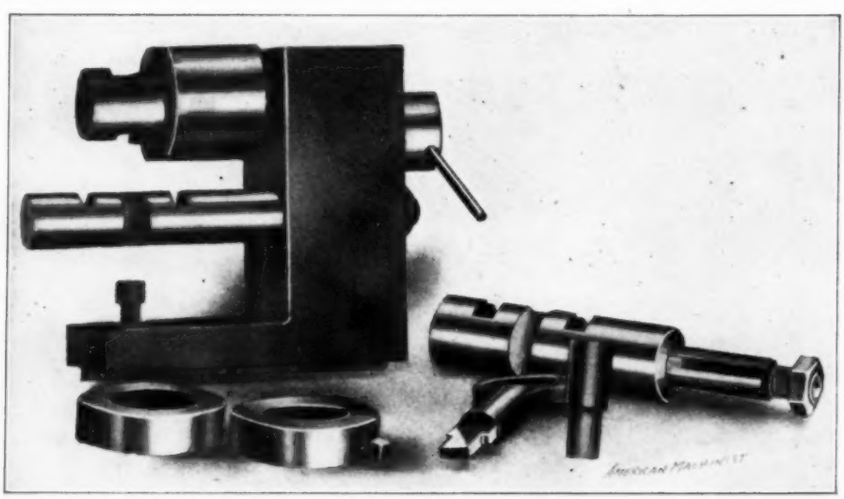


FIG. 9. SLOTTING ATTACHMENT, CUTTER AND OTHER PARTS

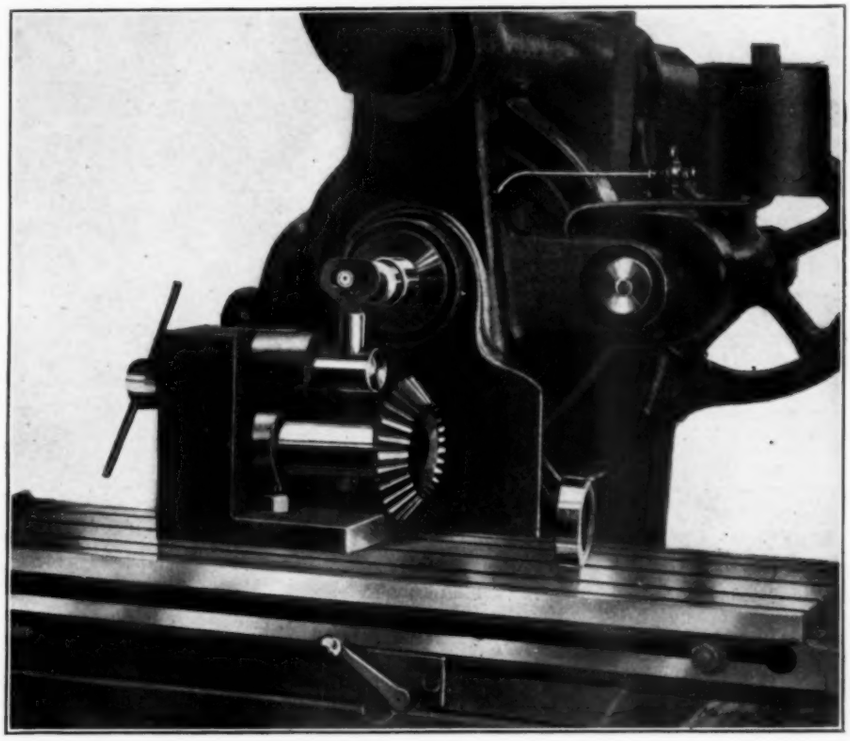


FIG. 10. SLOTTING OPERATION ON A GEAR HUB

run to sweep out the greater part of the metal for the feather opening, is mounted on the locating plug carried by the fixture, which plug is adapted to be fed longitudinally by means of a screw operated by the handle at the rear. This feed screw operates a sliding member *C*, Fig. 11, which has upon the inner end of its cylindrical body a groove engaging with a corresponding lip on the holder *D* which is secured to the work; therefore, rotation of the screw referred to imparts a longitudinal movement to the work and its carrier.

The plug *E*, upon which the work is mounted, is slotted vertically to receive a rectangular pilot *F* formed at the lower end of the cutting tool and acts as a support and guide for this tool, while the upper end of the bar *G*, which carries the tool, is enlarged and provided with an oblong opening to receive the eccentric projection upon the end of a driving arbor *H* whose taper shank fits in the mouth of the miller spindle. Upon starting the spindle, the eccentric driver produces a vertically reciprocating movement of the cutter bar and as the work is advanced against the cutting edge, the slot is machined out smoothly and accurately. The cutter is provided with

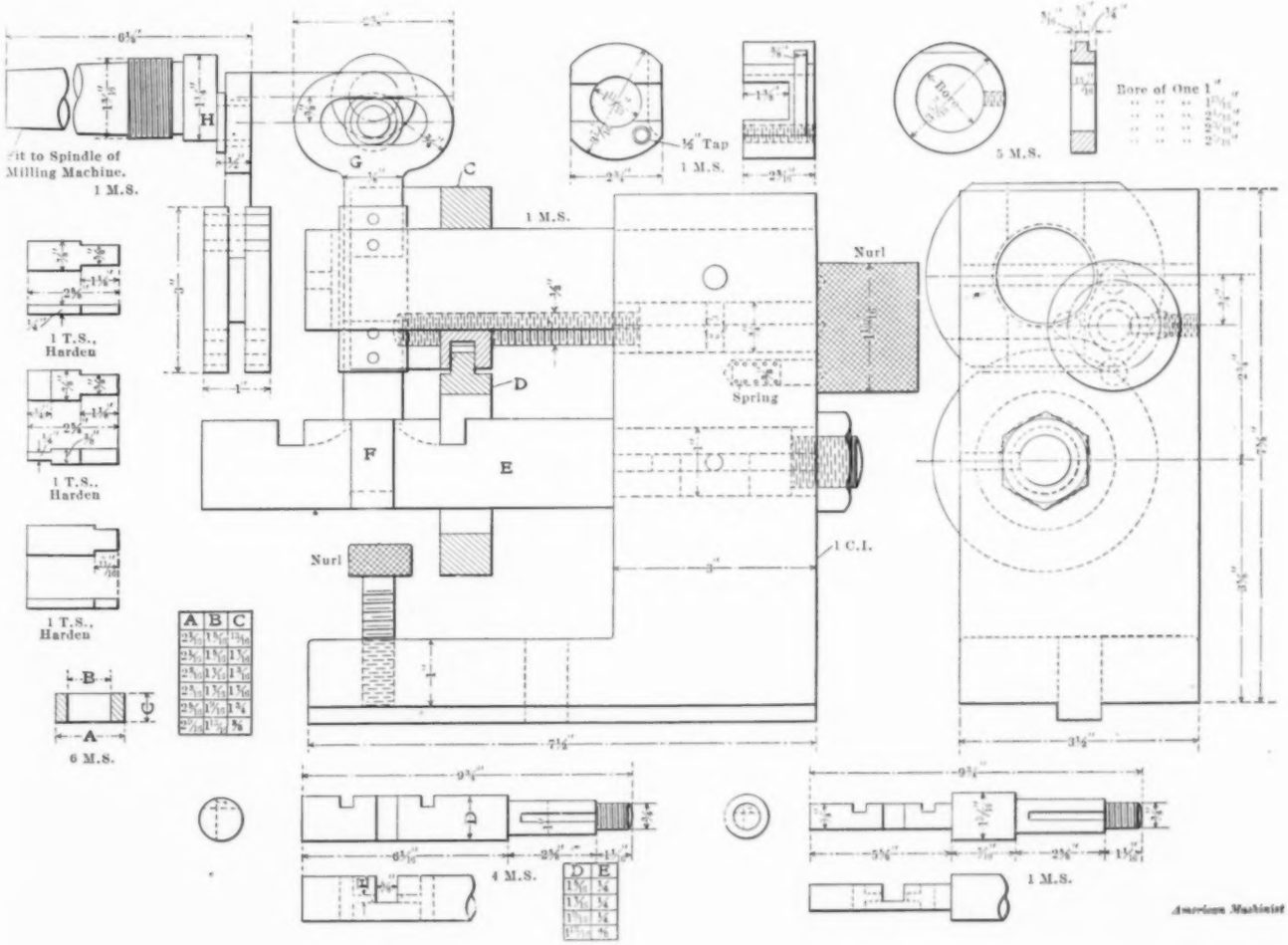


FIG. 11. SLOTTING FIXTURE FOR KEYWAYS

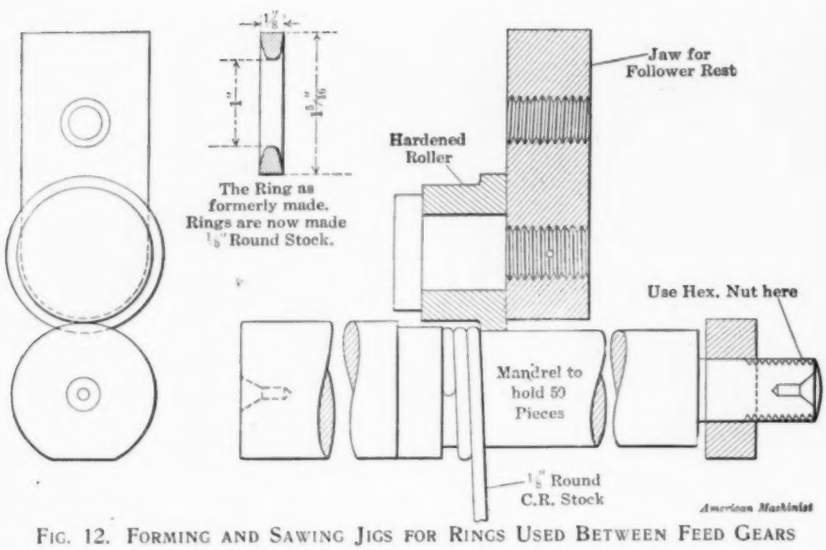

Jaw for Follower Rest
Hardened Roller
The Ring as formerly made. Rings are now made ⅛" Round Stock.
Use Hex. Nut here
Mandrel to hold 50 Pieces
⅛" Round C.R. Stock
American Machinist

FIG. 12. FORMING AND SAWING JIGS FOR RINGS USED BETWEEN FEED GEARS

two working edges and the operator merely feeds them forward and back for the machining of the two ends of the slot without having to turn the cutter or the work around.

RING COILING DEVICE

The feed gears in this radial are provided with a spring key which may be drawn from one gear to the next; and instead of using a formed ring between adjacent gears, as was originally the case, to enable the key to be readily shifted a ring made of ⅛-inch round steel wire is utilized. These rings are made by an ingenious method illustrated by Fig. 12.

First, a closely wound spring is coiled from the ⅛-inch stock by means of this arrangement, which is used in an engine lathe. The shouldered arbor is placed between the centers and a guide roll is mounted on the upper jaw of the steady rest. Both the arbor and the roll are filleted to the radius of the wire to be wound and the lathe is geared for cutting an 8-pitch screw, so that when the machine is started a smooth, nicely coiled job results. The arbor shown is just long enough to admit fifty coils, which means of course that the coil when cut forms fifty rings.

The cutting operation is accomplished in the milling machine by using a saw one thirty-second inch thick, this sawing operation being performed as soon as the coil is wound and before it is removed from the arbor. It is obvious that as the rings are severed by the saw, each ring will have a gap one thirty-second wide, and in computing the diameter of the coil allowance is made for the closing of the ring, end to end, when it is pressed into its seat in the hub of the gear. When the rings are closed they are at the same time twisted sidewise sufficiently to eliminate the helix and make the ring true on the sides.

TRUCK FOR DRILL HEADS

A convenient form of truck for holding and moving radial drill heads which have been finished and are ready for assembling on their arms is illustrated in Figs 13 and 14. Three of these trucks are used in the Gang shop and each holds five drill heads. The body of the truck is a rail machined to the same general

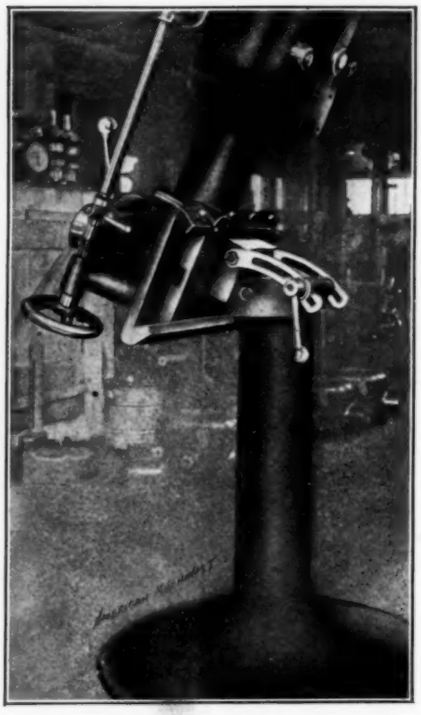


FIG. 15. A HANDY FLOOR STAND FOR RADIAL DRILL HEADS

form as the guide on the radial drill arm so that the drill heads may be slipped in place on the truck without injuring the machined surface at the back. The truck thus not only forms a handy device for transporting such work about the shop, but also provides a suitable support for the reception of the heads before they are ready to be mounted permanently on the drill arms.

FLOOR STAND

A convenient floor stand for holding radial drill heads while scraping and fitting up is shown in Fig. 15. The table is in the form of a guide to receive and hold the head by the planed seat at the back and, as indicated, the head may be tilted or swung to any position to accommodate the workman.

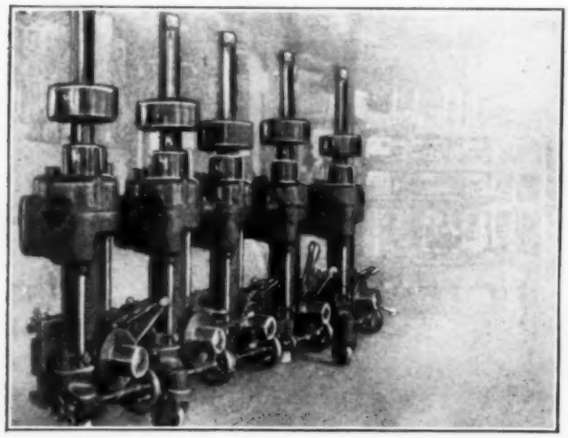


FIG. 13

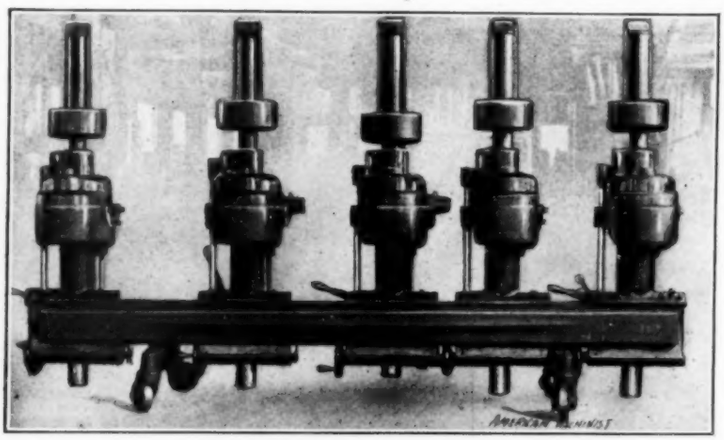


FIG. 14

SPECIAL TRUCKS FOR RADIAL DRILL HEADS

The Passing of the Old-time Fitter

By Henry G. Read

In the old days—Ah! how good, though, those old days were to us all as youngsters in spite of what we then thought to be unbearable and unfair hardships—the fitter was regarded as the man around a works upon whose skill hung a firm's reputation for well finished, accurate and durable work. Undoubtedly, he was justly so regarded, for on his skill, judgment and accuracy of setting out machine work and, after machining operations were done, the fitting of parts into one whole as a reliable piece of mechanism lay the difference between good and bad machines.

The hight of the machine fitter's skill and importance, speaking of him generally as in a trade branch, was probably reached during the period of 20 years between 1870 and 1890. Before this period, though plenty of good men considered purely as machine fitters undoubtedly existed, they were, as a majority, men who more strictly belonged to the class known as millwrights, a class they were to gradually supersede and the decline of whose importance came about mainly through the rapidly improving designs and accuracy of machine tools. For as firms re-equipped their works, the purely chisel-and-file man in preparing finished surfaces, became unnecessary and gradually became the fitter as we know him at that date.

The Predecessor of the Fitter

The millwright, who was the direct predecessor of the fitter, was in his heyday a real power in the engineering world. He was, truly speaking, a jack-of-all-trades and master of them all. He was always a passable blacksmith, a decent turner on the hand lathe, and later with the slide-rest; he was at the top of the tree with a heavy hammer and chisel, and a genius at getting things together in a manner which, if somewhat rough, was always strong and durable.

The old-time millwright often began his career as soon as he could toddle on his little feet, playing around his father's lathe or vise or his mother's loom or spinning wheel; picking up the names of the parts of these and their uses bit by bit as he learned his mother tongue. He was practically born a millwright. At an age so young that we, living under modern conditions, can scarcely credit the fact such little fellows were intelligently useful to their parents in their daily tasks of spinning, weaving, or repairing odd jobs of machinery and breakdowns. Often long before they were in their teens they were in mill or factory as apprentices, those who could, receiving a very elementary education of a sort meanwhile. These hardy little fellows were in too many instances kicked and cuffed around a works from one man to another as assistance was required here or there from time to time; first in one department, then in another. Intelligent, persistent instruction for them did not exist, or but seldom. They picked up their knowledge partly from an aptness engendered from their home surroundings and partly from the rough and ready kindness (?) of the workmen under whose charge they were in the works where they were apprenticed.

It says much for the hardy sterling nature and constitutions of our old-time youngsters that they not only managed to survive the rough treatment they encountered during their apprenticeship, but for the most part they developed into men of great skill and indomitable pluck and perseverance. In their day they were as much the mainstay of our old engineering works as their superseder, the fitter, was to become.

Not only could the millwright use tools, but he had to use them of every possible kind. He had to make his own patterns and core-boxes, forge his own chisels, etc. He did his own turning with "cockheel" and scraper and was ready to tackle any sort of a job, large or small, easy or difficult, pleasant or nasty. It was all one to the old-time millwright. He took off his coat to each and all of them cheerfully and finished them with satisfaction to all concerned.

Many jobs which came his way were such that his successor, the fitter, let alone our modern men, would shrink from in horror, even with a whole kit of modern tools and hydraulic appliances at his command. But the old-time millwright was just as cheerfully efficient when working up to his middle in the slush and grease of a wheel pit or sump, or hanging almost by his eyelashes on a shaky staging repairing the heavy gearing at the top of some old-time mill. It was all the same to him what the job was, where it was, or how great difficulty there was. The job had to be done and he did it in quick time too; his day has long been over, and now it is coming to the fitter's turn to be superseded.

Rise of the Fitter

As in Nature, so evolution plays its role in engineering and its processes, its customs and its men. The old methods of preparing working surfaces by chipping and filing of the millwright's day, were replaced by mechanically operated machine tools of primitive construction, but an immense advance over all hand methods. These tools being constantly improved so as to obtain increasing accuracy of the work done on them, this increasing accuracy gradually superseded the former rough and ready methods of works practice. Rusted-on fits, staked keys, liners to fill spaces between shaft and hole, and the hundred and one cute but unmechanical dodges to cover up imperfections in work, gradually disappeared. It was found that if work was carefully set out for machining, the majority of all these, so dear to the millwright, could be dispensed with, but that done, a near degree of accuracy could only be obtained by after use of file and surface-plate. It was mainly in this setting out and finishing work that the old-time fitter as we knew him, was born, grew, and became a power in his art.

The increased accuracy of the tool plant, the better designing, the furnishing of correct (sometimes) working drawings of machine parts and improved facilities for education, all tended to cause a more defined division of the old-time millwright's mechanical knowledge into specific trades, so that, later, lads entering into apprenticeship did so for one trade only.

The lads then began to enter the workshops at a somewhat older age, generally 14 years, they were articled to a firm at their specific branch, whichever it might be, for a period of seven years, or less, for if a lad entered a works above the age of 14, at 21 he became of age and his indentures lapsed. This system of the transition period between the decay of the old millwright type of mechanic, up to the advent of the modern, microscopically accurate types of machine tool in its several developments, was responsible for the making of the high-class fitter. The system undoubtedly worked well in spite of the great drawback it had of an absence of really methodical instruction to apprentices. Excepting in the works of here and there more far-seeing men, lads still had their knowledge knocked into them by means of more cuffs and curses than organized instruction. At the same time, if a lad was really worth his salt and had any sort of natural liking for his trade, he dodged the cuffs, ignored the curses, and soon picked up enough of his handicraft to gradually forge ahead.

As his ability to do things properly increased, the harshness decreased, and as he waxed older and stronger, an occasional bout of fisticuffs greatly ameliorated his standing in the workshop. In spite of all the drawbacks to the old-time system of apprenticeship, there can be no doubt as to its being responsible for good workmen, especially good fitters as then were needed. It was a very poor stick of a lad who could not in the seven years of his apprenticeship, make himself a fairly efficient workman. Often after this period he engaged as an im-

prover in another works for a period of two years, and then at the age of 23 or 24, was able to earn full wages at his trade and could be termed a first-class man.

Influence of Development of Machining Methods

At the period of which we speak, although the evolution of machine tools had brought them to a fairly high state of efficiency, yet they were far from being what they are today. The milling machine was scarcely known; certainly not as a general workshop tool. The twist drill was but just introduced, and, like milling cutters, was wrapped in cotton wool, or put in a glass-fronted showcase in the office under lock and key. It was regarded more as a sort of curiosity than as a practical, useful tool to be used to bore accurate holes. The shortsightedness of that generation of employers appears today incredible.

The system of working by jig and templet as we now have them, was practically unknown. The templets which did exist were for the most part made of thin sheet iron, were very inaccurate and used to mark out work in the old chalk and scriber way for machining, rather than as a tool for checking machine work when done.

All holes were measured out by compass and rule and centerpunch. The holes were bored by the decrepit, wabbling, flat drill, ground anyhow, and always perverse in use, preferring to run out or bore angular or oval holes. The drill ran out too much, a dirty bit of paper or old emery cloth was packed round it, or it was whacked with a hammer as a persuader to go in the way it should. If the hole was running out, the driller whittled a bit of metal out on the opposite side with a stub chisel and unless a careful man, the drill then took a fancy to run off to the opposite side.

Much the same happened with work in the lathe. All sorts of barbarisms were practised to get work to run somewhere near true in it. As a rule, the point of the center held the work by sheer end pressure. If a hard place was met with in the bar the work was then able to spring on the centers and something not particularly round resulted. To drill up a center in those days was tabooed, and a man so doing was considered worse than a crank.

In planing jobs all sorts of odds and ends of packing pieces were used, with no thought as to their suitability, and it was indeed seldom to find planing work that was anywhere near accurate enough to place in mechanism without filing, and often chipping too. The file was then the turner's friend. Even today in spite of our enlightened methods, this spoilation of a good lathe's work is in many shops still in evidence.

As to the way castings then came from the molding shop, the less said the better. Too often they were full of blow holes carefully filled with "kit," a compound of filings and putty, often not discoverable till the casting broke down in the finished machine. The surfaces of castings were horribly rough and uneven and full of blisters, core fins and other defects too numerous to mention. The consequence of all this jumble of poor castings and inaccurate fudging machine work, was that the skill of the fitter was relied upon to put the whole into a shipshape condition, and from the whole to file, chip, adjust and fit, until he produced a machine or piece of mechanism that would prove durable and as accurate as work under such conditions could be made. It was here that the fitter found his place. Without his skill machinery could then not be produced and on the class of man, good, bad, or indifferent, in whose hands the fitting up of machinery was placed, such machine became likewise good, bad, or indifferent.

Influence of Development of Machine Tools

Gradually, since about the year 1890, more rapid evolution has taken place in the development of the machine tool. This is greatly due to the high degree of accuracy needed in all branches of electrical engineering, to obtain which the old "fitter" processes proved too cumbersome, lengthy, expensive, and in the end without any possibility of having interchangeability of parts. Then again, the development of the internal-combustion motor, especially of the high-speed types for motor-vehicle work, demanded the highest degree of accuracy and interchangeability, more so, perhaps, than the electrical branch of engineering. In fact, whichever way one turns, the demand for extreme accuracy of modern machine-tool plant is seen. Probably the two main elements of machine tools today are those for performing milling and grinding operations, operations to replace the chisel and file; in other words, tools to replace fitting operations and, as a natural consequence, the fitter too. Undoubtedly, the introduction of the accurate jig and templet system for machine operations and the finishing of parts ready for assembling by means of fine milling and finishing grinding machines, means the decay of the fitter and his replacement by what we may term the assembler; just as at an earlier date the fitter replaced the old-time millwright.

Fitter Replaced by Assembler

Today in a well equipped and well organized workshop there is in machine construction no place for the old-time fitter. All his skill and patience is unnecessary. Except in special cases the old-time method of setting out work is not required. Parts of machines are cast after being molded on an accurate machine; all core sand and scale are removed by sand blasting and pickling; the parts go to the machine shop direct from a store, are placed in a jig, and holes bored thereby to the thousandth of an inch. They go to a milling machine and are machined by formed cutters to the necessary profile, or by gang cutters as the case may be and to a templet for depth, width or thickness. Bars go to the capstan lathe and are turned and formed out of the solid. If the parts are forgings, they go to machines specially designed to handle them, and all are finished to limit gage, without the use of the "turner's friend," the file. Thence these parts all pass to the finishing grinding machine, where needed, being first hardened.

Every part of a job carried out in such a modern works is made a machine job; is inspected and reinspected and controlled with limit gages, till, when a machine comes to be erected, the assembler has but to receive the various parts from store, remove here and there a sharp edge or tool mark, and perhaps bore a hole or two and tap by hand where inaccessible on a machine and bolt the whole together. He may have to adjust a trifle here or there, but practically everything that the passing fitter would formerly have had to do will be absent, but the machine, when finished, if made by a reputable firm, will be of a degree of accuracy in its parts and functions of which the old-time fitter never dreamed and never could have accomplished, had he spent his lifetime on the job.

The old order changeth; the fitter of our boyhood is passing; he is being replaced by the assembler of our modern workshops. In a few short years he will be found only in the tool room, on special work or at repair jobs, where he will always have a place, but his day in the workshop as he was formerly known and appreciated, is done.

He was a new arrival in this country and his vocabulary limited. Presenting himself at the office, he told the office boy, in broken English that he was a tool maker in search of work.

The boy took his message to the busy superintendent, who told him to ask the applicant certain questions.

The Swede listened stolidly to the boy's flow of oratory which he did not understand.

Returning to the superintendent, the boy said: "Dat Dutchman don't speak no United States." "Then I guess we don't want him," replied the super, as he turned to his work.

Out in the office, the boy told the greenhorn he was not wanted.

"Vy?" asked the Swede.

"Because you don't talk no English," the boy replied.

"Ay vant not yob for talk. Ay bane vant yob for work," said the Swede. And he got it.

New Design of Steel Plate Edge Planing Machine

The interesting plate-planing machine shown in Fig. 1, is a new pattern by Wm. Sellers and Company, Incorporated, Philadelphia, Penn., and is designed to plane steel plates 3 inches thick, 24 feet long, at one setting, and greater lengths of large dimensions with nine inches vertical and two inches horizontal adjustment of feed of the tool slide. The tool carriage is shown in Fig. 2. The feeds are by hand, and the tool holder is turned over by the operator at each end of the beam or any yielding of the plate, while with jacks the setting up of one tends to loosen another, and the reverse is true when the plate is being unclamped. The operator's working position is upon the platform attached to the carriage.

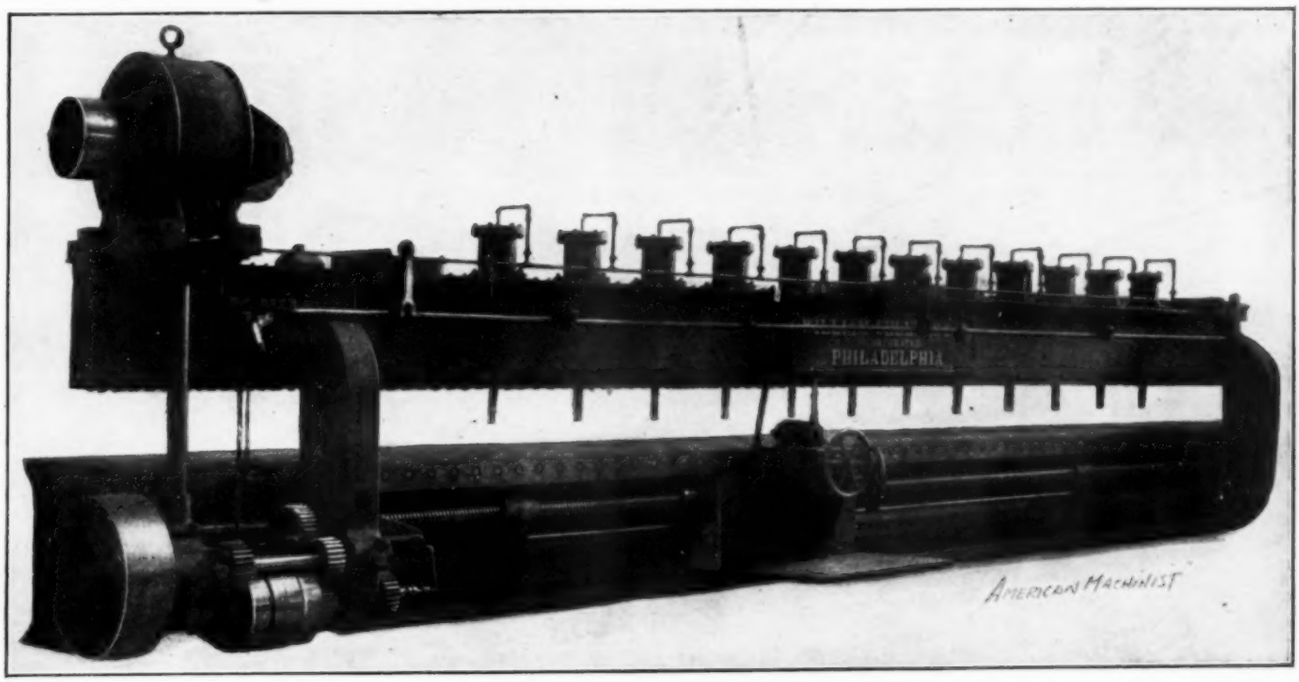


FIG. 1. PLATE-PLANING MACHINE

by shifting the plate. The bed is a very deep cast-iron box beam of ample width, with its top forming a table for carrying and attaching the work to be planed. It is provided with both vertical and horizontal bearing surfaces for the carriage, the sliding surfaces subject to wear being gibbed, while the shoes resisting the outward carriage pressure of the cut are attached to the bed in sections, so as to permit the ready removal of the carriage for repairs when necessary, without removing the end housings or taking out the driving screw. The carriage is also

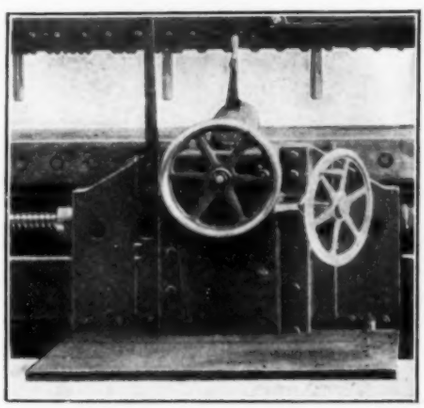


FIG. 2. THE TOOL CARRIAGE

stroke. (The tool holder can be provided with swiveling motion if desired, thereby permitting the use of tools ground straight on face instead of bevel.) The machine is driven by a 40-h.p. electric motor through belt and gears to a pneumatic reversing clutch, and thence to the screw 4 15/16 inches diameter with roller bearings at each end to take the thrust. Adjustable bearings to support the screw are moved to position by the carriage. Two cutting speeds of 18 and 35 feet are provided, and these are obtained by reversing one pair of gears on taper bushings, the change from one to the other being made very quickly. The driving mechanism is shown in Fig. 3, the reversing pair of gears showing on the inside of the housing. In reversing, a projecting rod on the carriage actuates stops on the shifting rod carried on the clamping beam, and thus shifts the air valves. The clamping beam is a deep box girder carrying the clamping cylinders centrally, and each cylinder is provided with stop valve, so that all or any number can be in operation at the same time. This method of clamping has advantages over screw or hydraulic jacks, as the plunger with the air pressure behind it responds automatically and uniformly to any deflection in the clamping

The machine was designed and built for the New York Shipbuilding Company, Camden, N. J., for planing vanadium steel, such as is used for deck plates, etc., of armored ships, and is a noteworthy development.

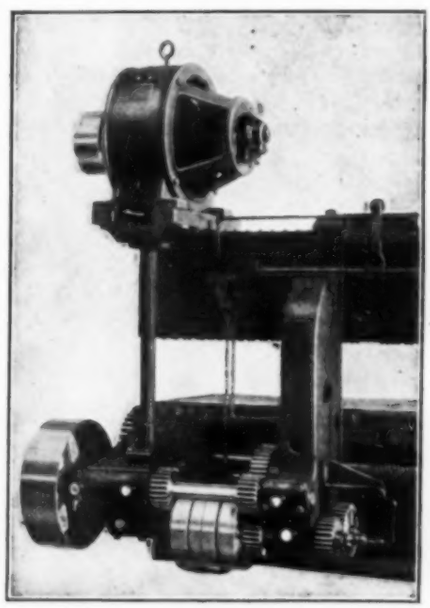


FIG. 3. THE DRIVING MECHANISM

Development of Motors for Aeroplane Requirements

Interesting Designs and Construction of the Principal Makes

By Augustus Post

Up to the present time our friends from across the water seem to be the only ones who have been sufficiently interested or disposed to develop gasolene engines primarily suitable for aviation purposes. It is not unnatural that among those who have been foremost in this work are the names of many of the best known foreign automobile builders.

In the accompanying halftones are illustrated some of the products of these manufacturers, and while some of them are of such unusual form as almost to come under the category of "freaks," there are many others not illustrated, whose design are many times more radical.

The Wright Motor

The Wright motor shown in Fig. 1, as constructed in France for the Société Navigation Aërienne, is a four-cylinder, vertical, water-cooled engine, made from the designs of the Wright brothers and similar to the motor made by them in the United States. The cylinders are cast separately and bolted to an aluminum crank case; they are fitted with aluminum water jackets and have a bore of 4.41 inches, and stroke of 3.94 inches. The valves are located in the cylinder heads; the inlet valves are automatic, while the exhaust valves are mechanically actuated. The inlet valves are connected together by a large pipe, into which, through a large opening, gasolene is directly introduced by a small pump in the crank case, driven from the crank shaft.

The gasolene is mixed with the air in the large pipe and there is no carbureter properly speaking, the explosive mixture being formed immediately in the intake pipe, and the quantity of gasolene supplied varying directly with the speed of the motor.

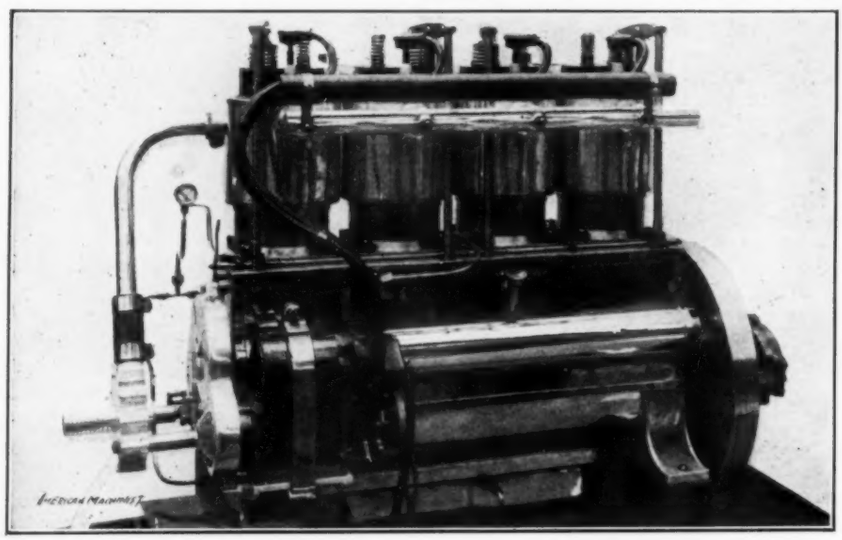


Fig. 1. Wright Motor

Water is circulated by a geared pump at the forward end of the motor.

Oil is also circulated by a pump, which raises it from a reservoir under the crank case, and distributes it to the bearings; the pistons and cylinders are oiled by splash. Ignition is by magneto, and the speed of the engine is 1400 revolutions per minute, giving about 30 horsepower. The engine weighs about 200 pounds.

Clement-Bayard Aeroplane Motor

The Clement-Bayard 50-horsepower motor shown in Figs. 2 and 3, like the "Gnome" uses seven cylinders in order to get equally spaced explosions on a four-cycle principle and to render unnecessary the use of a flywheel; for there are seven explosions for every two revolutions of the motor, each alternate cylinder being fired in succession.

The cylinders are turned from a solid bar of steel, but the heads are made separate, dome shaped, screwed into the cylinder and brazed. Copper water jackets are fitted to the cylinders.

The combustion chamber is hemispherical and the piston head is concave. The bore is 4.3 inches and the stroke 4.5 inches.

The built-up crank shaft has one throw, and is mounted on ball bearings; the connecting rod of one cylinder has provision for taking two other connecting rods on its bearing, while two other connecting rods have the remaining two connected to their bearing, one on the right side and the other on the left. Balance weights are used to adjust the equilibrium, but no flywheel is used. The valves are placed in the cylinder head and a double-acting rocker arm opens the inlet or the exhaust valve of each cylinder. It will be noticed that flat springs are used in a very ingenious manner.

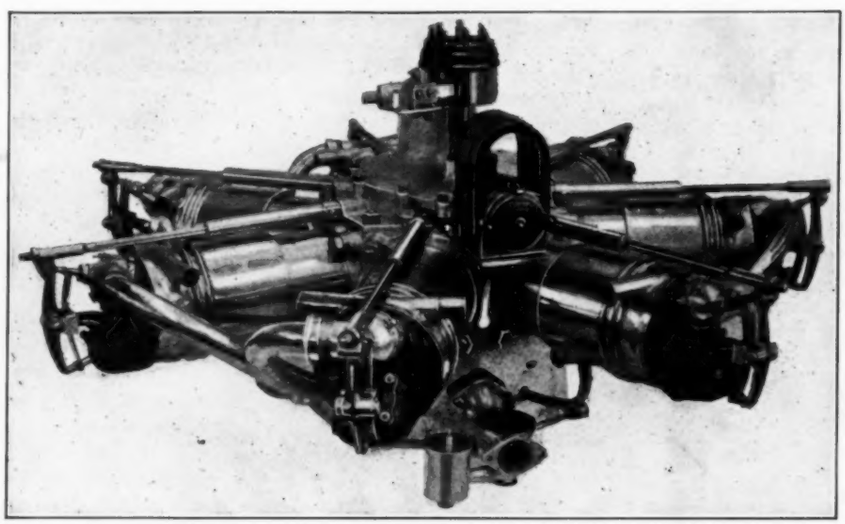


Fig. 2. Clement-Bayard 50-horsepower Seven Cylinder

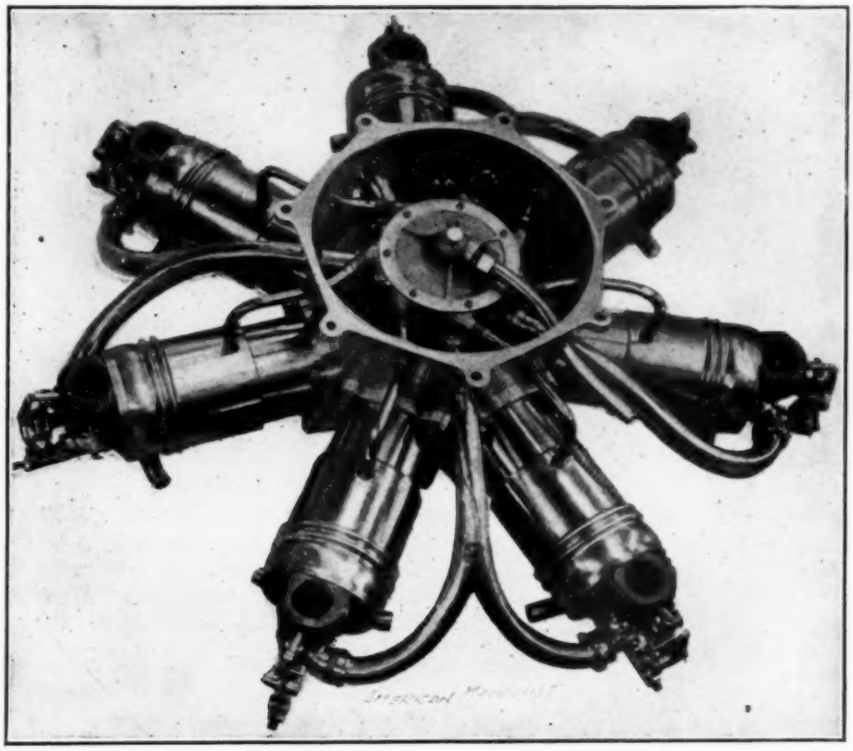


FIG. 3. CLEMENT-BAYARD 50-HORSEPOWER MOTOR, CRANK-CASE COVER REMOVED

A centrifugal water pump will be seen in the center of the crank-chamber base, operated by the main crank shaft, and with a water connection to each cylinder.

The carbureter is quite small and light, and is attached to the base of the crank case. A high-tension magneto seen on the upper part of the crank case furnishes the ignition and is driven by bevel gear.

The engine was built for an aëroplane constructed by M. Clement, on plans of M. Tatin, and had a horizontal flywheel on the vertical shaft between the engine and the reduction gear.

CLEMENT-BAYARD DIRIGIBLE MOTOR

Fig. 4 shows one of the 200-horsepower Clement-Bayard motors for dirigibles, mounted as a unit with clutch and gear box on a bed frame and suspended by springs.

This engine is a four-cylinder, vertical, water-cooled motor, of the latest Clement racing type. The cylinders are cast separately and are copper jacketed; have a bore of 7.48 inches and a stroke of 9.05 inches, giving a horsepower estimated at over 200. The valves are mechanically operated and placed in the cylinder head. A magneto is used for ignition. The weight is 1100 pounds.

There will be two of these motors used in the new Clement-Bayard airship being constructed for the British government; each motor having a propeller of its own, although when desired, both motors can run one propeller, or one motor can run two propellers.

PANHARD

The reputation which the well known firm of Panhard & Levassor have for building reliable motors for automobiles will no doubt, be extended by their aëroplane motors. The new motor shown in Fig. 5, which they have constructed for aviation, is remarkable for its simplicity and comparatively light weight, without being in any sense delicate as far as its essential organs are concerned.

In appearance, it looks very much like a standard four-cylinder automobile motor with a long stroke, but it only weighs 210 pounds, while it develops about 45 horsepower on the brake. The cylinders are of nickel steel with 4.33 inches bore and 5.51 inches stroke. Copper water jackets are welded to the cylinders. The carbureter is very simple and is placed at the middle of the inlet pipe. The air inlet is fitted with an adjustable opening.

One of the principal points of interest about this motor is the double, or combined inlet and exhaust valve. The two are made concentric, one working inside of the other. The valves are operated by a single push rod, actuated by the cam shaft.

The Panhard Company also build engines for dirigibles, and it is the only make of engine used in the air ships of the War Department (French?).

FIAT

An interesting aëronautical motor shown in Fig. 6 is made by the F. I. A. T. Company, of Milan, Italy, who have been so successful in building high-power racing automobiles and motor-boat engines.

This motor is a 50-horsepower, eight-cylinder, V-type, air-cooled engine with ribbed cylinders made extremely light and all superfluous metal cut away to the limit of safety. The valves are in the heads of the cylinders, mechanically operated. Two magnetos are used, one for each set of four cylinders.

DARRACQ

The Darracq 35-horsepower engine

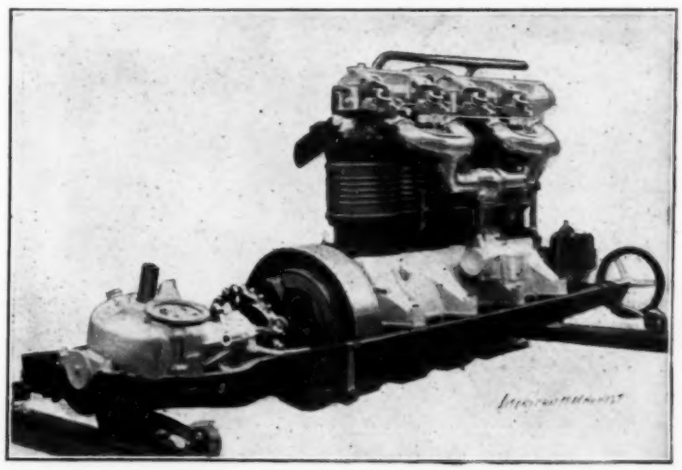


FIG. 4. CLEMENT-BAYARD FOUR CYLINDER, 200 HORSEPOWER

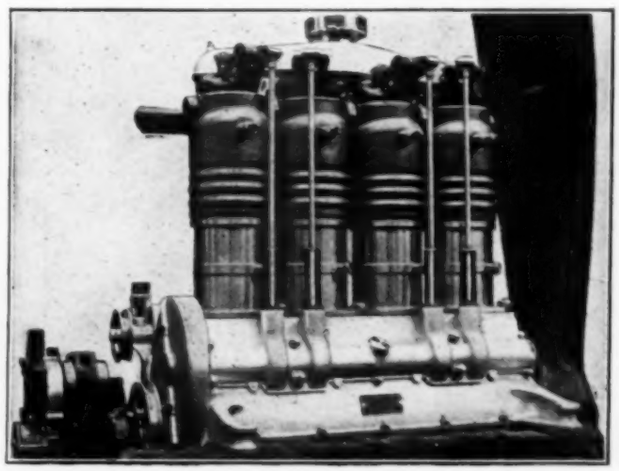


FIG. 5. PANHARD-LEVASSOR FOUR CYLINDER, 40 HORSEPOWER

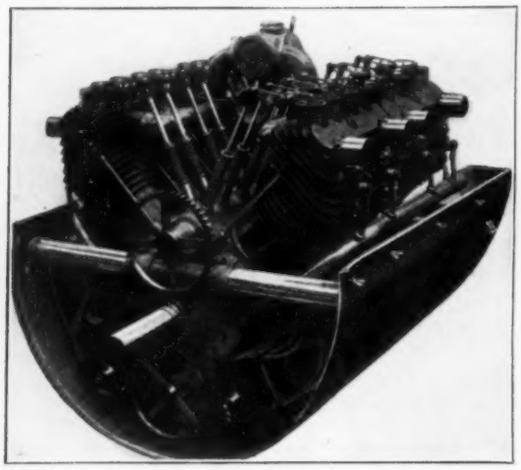


FIG. 6. FIAT EIGHT-CYLINDER MOTOR

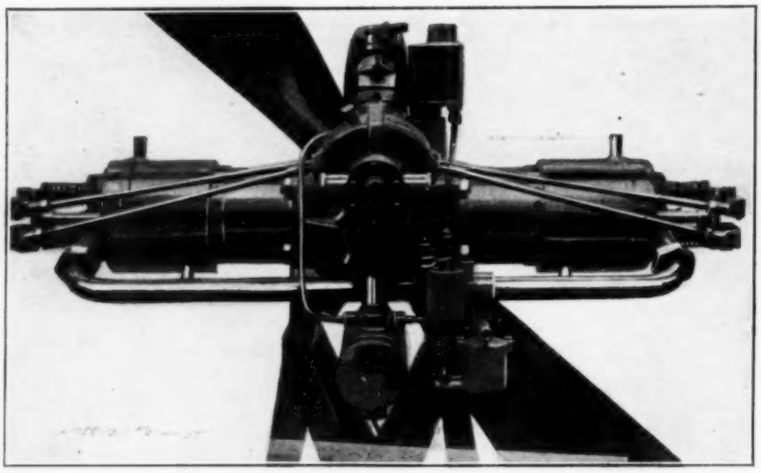


FIG. 7. DARRACQ 35-HORSEPOWER MOTOR

shown in Fig. 7 is the motor used by Santos-Dumont in his famous aëroplane, the "Demoiselle," which is the smallest flying machine yet made and the cheapest now on the market.

It has two opposed, water-cooled cylinders, cut from solid steel, of 5.12 inches bore and 4.72 inches stroke fitted with silver soldered, copper water jackets. Both of the valves are set in the cylinder heads and are operated mechanically. Auxiliary ports are cut in the cylinder, to enable the exhaust gases to escape directly into the air at the end of the stroke. The magneto and water pump are driven by a shaft connected by bevel gear to the main crank shaft.

Lubrication is furnished by an oil pump. The weight of the engine is 114 pounds and it runs at a speed of 1500 revolutions per minute.

RENAULT

The Renault 25-horsepower aviation motor shown in Fig. 8 the smallest model made by this firm. It is a four-cylinder V-type, air-cooled engine of very compact design with separately cast cylinders, 3.54 inches by 4.72 inches, with air-cooling ribs. The ribbed cylinder heads are independent and held in place by a yoke passing over their tops, secured to the crank case by four long bolts, which also hold down the cylinders. All valves are mechanically operated, the exhaust valves being directly over the intake valves and the cam shaft being just above the crank shaft. Pump lubrication is provided. Inclosed-hood fan cooling system is intended to be used.

The engine weighs 253 pounds and gives 25 horsepower at 1200 revolutions per minute.

The Renault firm also manufactures a 50-horsepower 1100 revolutions per minute water-cooled four-cylinder motor of the vertical type, with separate cylinders of 4.33 inches bore and 6.3 inches stroke, and weighing 286 pounds.

RENAULT DIRIGIBLE POWER PLANT

The Renault Freres have constructed a special power plant for dirigible balloons, shown in Fig. 9, by mounting one of their 80-horsepower, four-cylinder, water-cooled engines, with radiator, upon a bed frame with engine pan, very similar to the manner of mounting an automobile motor. This frame, complete, is hung upon springs to absorb the vibration which might be transmitted to the car of the balloon. The cylinders of this motor are cast in pairs with 6.3 inches bore and 5.9 inches stroke. The valves are placed

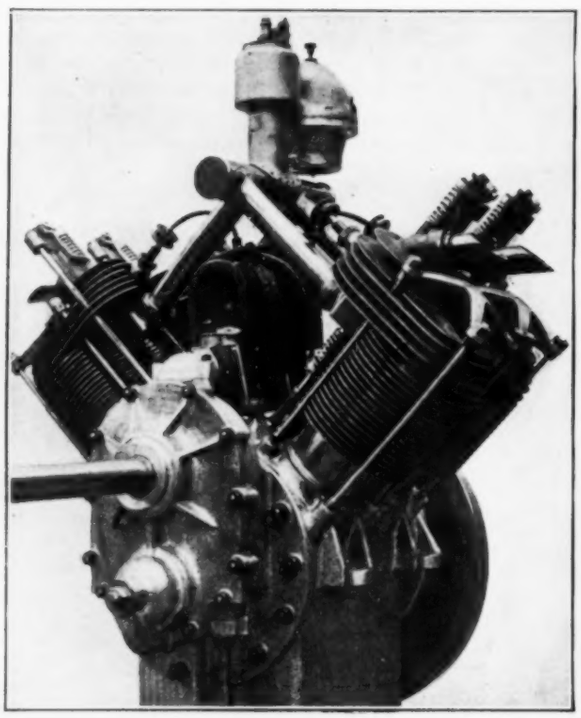


FIG. 8. RENAULT FOUR-CYLINDER, 25- HORSEPOWER ENGINE

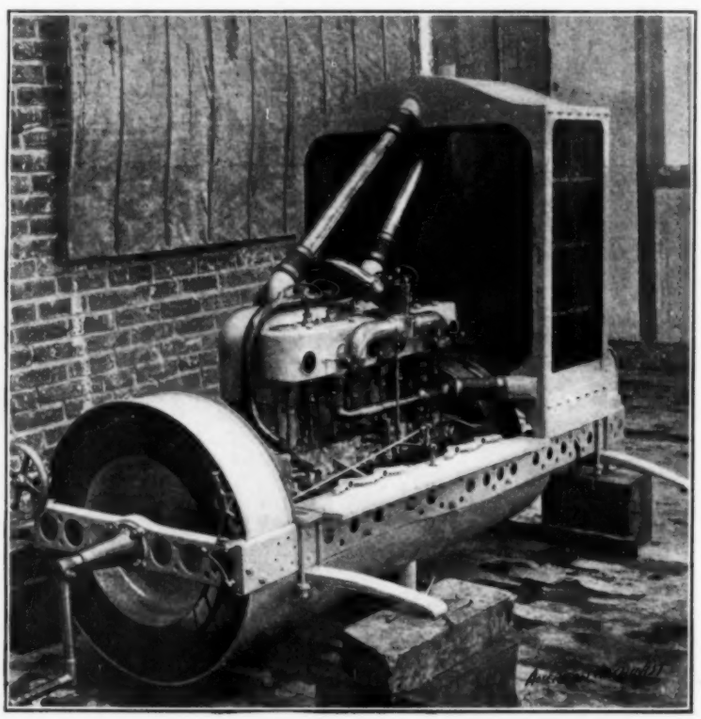


FIG. 9. RENAULT 80-HORSEPOWER DIRIGIBLE

in valve chambers on the side of the cylinders and are mechanically operated. The ignition is by high-tension magneto. Cooling is by the thermo-siphon system with Renault small-tube radiator. The speed of the motor is governed by a throttle valve, moved by a lever on the right-hand side of the frame, which can be seen in the halftone.

Some Uses of the Disk Grinder

Special Correspondence

The illustrations show some interesting work handled on the disk grinder built by the Ransom Manufacturing Company, Oshkosh, Wis. The machine shown is a 27-inch with 23-inch disk. The illustrations show the work and method of handling so clearly as to render unnecessary an extended description. Fig. 1 illustrates the method of grinding the end of a gray-iron exhaust manifold which is clamped securely by the means indicated and ground by passing the work over the face of the disk. In Fig. 2 the manifold is shown set up for the grinding of the four flanges. Here the work is supported in a pair of V's and held by two readily applied clamps. Fig. 3 shows the way small grinder bases are finished on the bottom. The construction of the holding fixtures in each case will be obvious upon inspection of the halftones and the method of adjusting the work to the disk and manipulating it during the grinding process will also be seen at a glance.

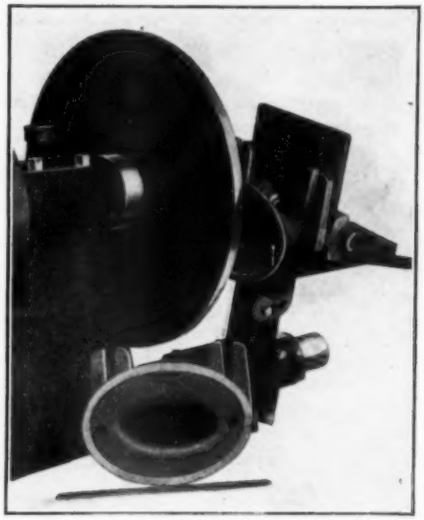


FIG. 3. GRINDING BOTTOM OF SMALL GRINDER BASES

Centimeters Per Square Inch

A contributor calls our attention to this gem from a recent issue of a popular weekly. The italics are ours.

"It has been found, in testing iron by repeated stresses, that in one case four hundred thousand applications of a stress of *five hundred centimeters to the square inch* caused rupture."

We have seen many attempts to lift the haze from the real meaning of the word stress; but until now did not realize that it must be expressed in a combination of Metric and English units. Undoubtedly 500 centimeters to a square inch is severe treatment, especially to the reader.

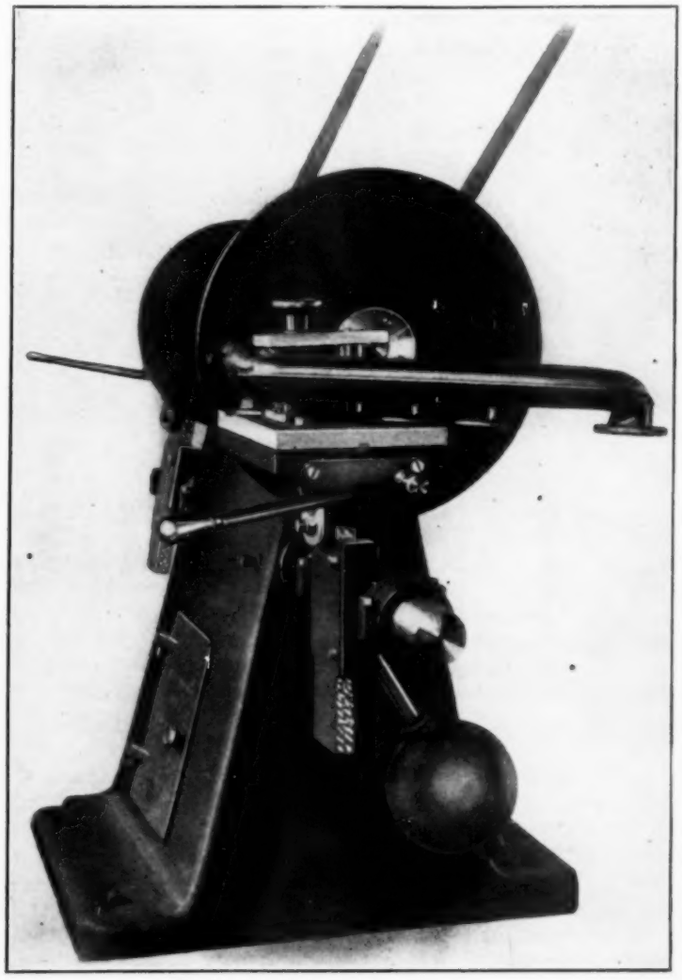


FIG. 1

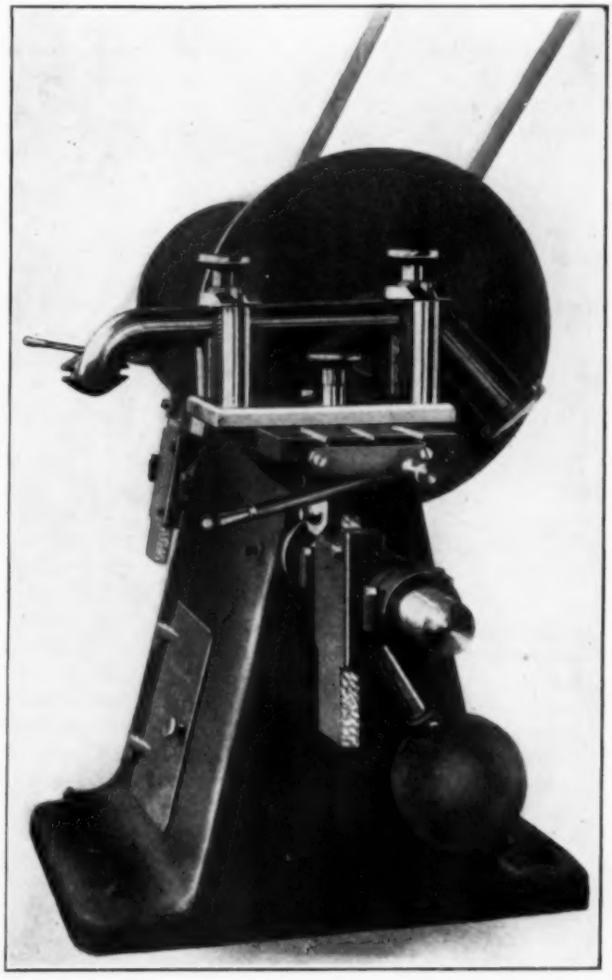


FIG. 2

GRINDING EXHAUST MANIFOLDS

Hydraulic Step Bearing for Index Table

By Robert Reid

The question of handling the various heavy parts of modern electric generators has become quite an item with the various firms building this class of apparatus and more especially is this so during the various machining operations, where it becomes not only a question of handling the weight, but the accurate setting up of the piece and the duplication of the operations, such as the drilling, milling, or slotting of a number of grooves or slots across the face of large, heavy, circular pieces, as shown in Fig. 1.

This shows a very heavy type of revolving field, having special T-slot

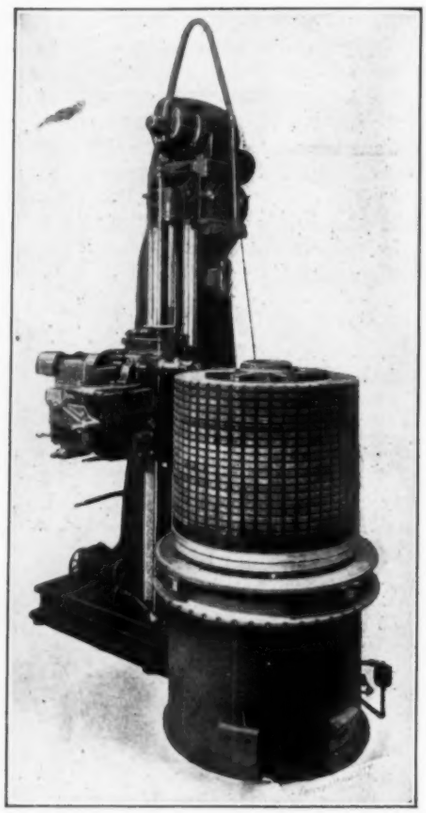


FIG. 1. HYDRAULIC STEP BEARING HAVING INDEX TABLE

grooves milled across the entire face, the diameters varying from 4 feet to 7 feet 3 inches. The slots are from 48 to 80 in number and the length of slot from 38 to 62 inches, while the milled portion consists of a number of steel laminations, 1½ inches in thickness, placed one upon the other until the proper length has been obtained. The stock is roughed out by drilling before assembling, and after assembling they are placed on a slotter, where still more of the material is removed. It is then transferred to the special milling machine shown in the figure. Here the work is placed on an index table, but by reason of the enormous weight, some of these parts, varying from 6 tons to 40 tons in weight, it was found to be almost impossible to obtain accurate indexing, and in order to overcome this difficulty, the hydraulic step bearing shown in section in Fig. 2, was designed. By reference to this figure, it can be seen to consist of a cylindrical cast-iron base, accurately machined, top and bottom, in which is a hydraulic cylinder. The plunger, or ram, 8 inches in diameter, is extended upward, becoming not only a guide, but also a center for the piece to be machined.

While capable of a greater lift, it is only designed for a lift of 1/64 inch; just enough to remove the weight from the top flange of the supporting base, and is used only while indexing. When the work has been moved or indexed to the next position, it is locked in place by means of lever *a*, the water is allowed to escape, while the work settles down upon the supporting base, ready for milling.

One of the principal features of this bearing is the means provided to prevent a greater lift than that for which

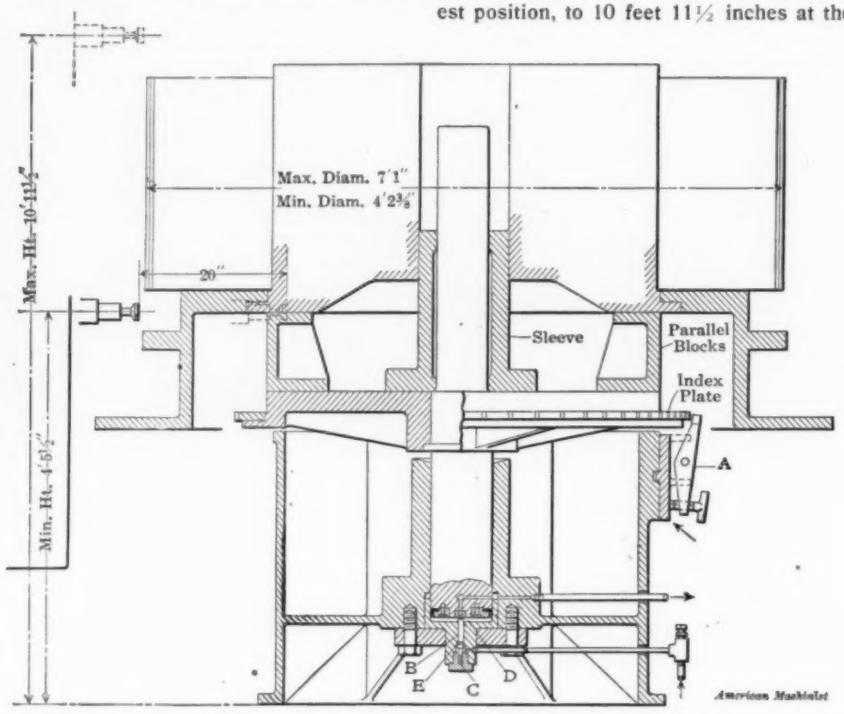


FIG. 2. SECTION OF INDEXING TABLE SHOWING HYDRAULIC STEP BEARING

it was designed, and is as follows: A double face valve *B*, is placed in bottom of cylinder, and rests upon a helical spring *C*, capable of holding the valve up against the face *D*, which is located in the base of the ram; the other face *E*, being located in the bottom of the cylinder. When the discharge valve (not shown) has been opened, the ram in settling down, pushes the valve *B*, downward against the spring, thereby opening the lower port in the cylinder. When necessary to raise the work, the discharge being closed and the inlet opened, the water entering, passes the lower open valve, up into the cylinder, through grooves in the valve stem. As the plunger rises, the spring, expanding, lifts the valve up against the seat in the cylinder, thereby automatically closing it, while, if there should be any leakage of water past this valve face when closed, tending to lift the ram still higher, the valve in the end of the plunger is thus automatically opened and the excess water is allowed to escape through the small hole drilled in the plunger for this purpose. This makes a very effective safeguard against any excessive lifting of the work and provides a very easy means of indexing heavy work of this nature.

The 2-spindle Newton milling machine here shown, was specially designed for this particular work and calls for some attention. The two milling spindles are mounted upon a substantial driving head, this head having a vertical adjustment varying from 4 feet 5½ inches, at the lowest position, to 10 feet 11½ inches at the highest, while the milling spindles, which are fixed on the horizontal plane, have a side adjustment of 20 inches. The axis of the spindle nearest to the column is always parallel to the face of the column, while the other is capable of swiveling through a certain angle, which permits of setting the spindle upon radial lines with the part to be machined. By this means it is possible to mill two slots at the same

time, this being a very important feature, by reason of the length of cut, which varies, as stated, in this particular class of work, from 38 inches to 62 inches, requiring considerable time. The column of the machine is mounted on a sub-base and is capable of a horizontal adjustment to suit the diameter of the work. It has an all-gear drive, using CR 10-10 horsepower motor, with variable speed. The entire machine is self-contained, and may readily be transferred from one part of the iron floor plate to another. The device is in use by the General Electric Company, of Schenectady, N. Y.

Solution of a Difficult Conveyer Problem

The mechanical solution of difficult problems are, as a rule, both interesting and instructive; and the design and construction of a conveyer for particularly severe service in the offices of *The Boston Globe* is no exception. The machine was designed and patented by J. H. Long, and built by his firm, the J. H. Long Machine Company, 184 High street, Boston, Massachusetts.

The problem to be solved was the installation of an automatic carrier system to transfer curved stereotype plates from the stereotyping room on the seventh floor to the printing room in the basement, at the rate of seven per minute. As the exterior of these plates is the printing surface, it was imperative that the automatic device should so handle and control the plates that the surface would not be hit, scratched or otherwise injured.

Fig. 1 shows the mechanism in the stereotyping room, and Fig. 2 the delivery end in the press room.

The conveyer proper consists of two endless chains carrying suitable holders for the plates. These chains have a vertical run between the press room and the stereotyping room and a short horizontal run for receiving the plates, shown at the rear of Fig. 1, where also can be seen a holder ready to come into position to receive a plate. This holder is indicated by the letter *A*.

In front and below this horizontal section of the conveyer is an endless slatted belt, indicated by *B*, Fig. 1. This belt forms the mechanism that delivers the plates from the shaving machine to the conveyer proper. To outline its use; a finished plate is delivered to it from the shaving machine. Its speed is faster than the speed of the conveyer proper, thus, as it travels forward, it is carried into a holder on the conveyer, while both holder and the short endless belt are traveling in the same direction. Once in the holder, the plate is carried to the bottom of the shaft, released by gravity and slid out upon a runway, as shown in Fig. 2.

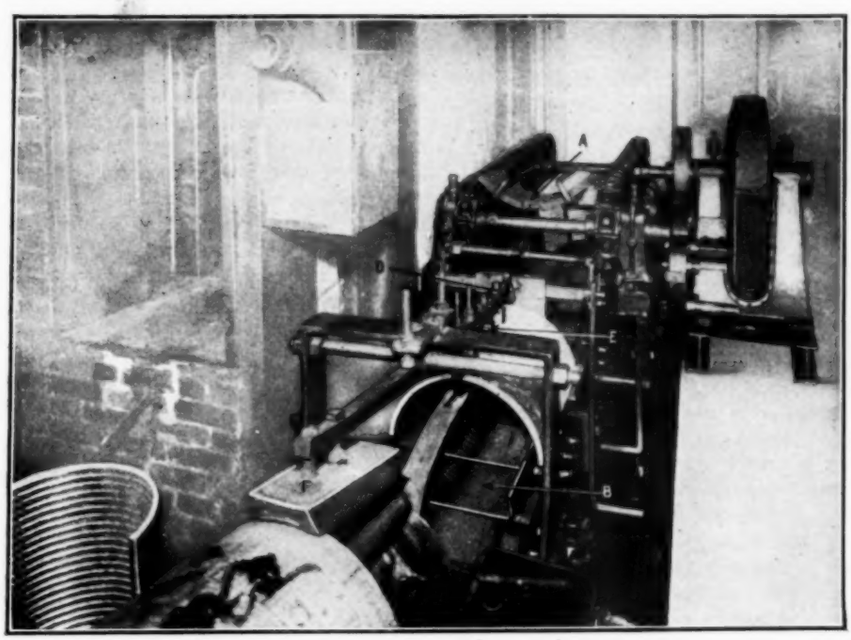


FIG. 1. UPPER END OF CONVEYER

A holder is best seen empty at *A*, Fig. 1, and with a plate in place at *C*, Fig. 2. It consists of a double-pronged hook having a curved back that is either made of wood or of metal, with a leather facing. Against this back the printing face of the plate rests, and is thus protected against injury. In order that only one plate may be presented to a holder at a time, and to insure that the plate will be properly entered in the holder, before the holder starts downward, several safety devices are used. In Fig. 1, a plate upon the endless slatted belt is seen in contact with a leather-faced stop *D*. This stop is ripped out of position by a cross bar on a plate holder at such a time that the plate will move forward and enter the holder securely before the holder starts downward. Thus it is impossible for a plate to be carried along the short endless belt and dropped down the shaft from failure to have entered a holder.

To prevent one plate from over-riding another, a pad at *E* rests upon the plate that is awaiting a forthcoming holder and through a bar presses a brake *E* upon the following plate, see Fig. 1, thus holding it back until the preceding plate has passed on to its holder. This spacing device insures that the plates shall be delivered to the conveyer successively.

FIG. 2. LOWER END SHOWING HOLDER

The mechanism is driven by a five-horsepower motor through suitable gearing. The casing for this gearing can be seen at the extreme right in Fig. 1.

After the plates have been used in the press room, they are returned to the stereotyping room for remelting by the same conveyer, in which case it is only necessary to reverse the mechanism.

Letters *from* Practical Men Concerning *the* Details *of* Making things *in* Machine shops, *from the* First Sketch *to the* Sale

Size Blocks and Hight Gage

I have noticed from time to time in the columns of the AMERICAN MACHINIST different types of hight gages and measuring blocks. I wish to give a brief description of a couple of home-made tools of the measuring and hight class, which any mechanic may easily provide for himself.

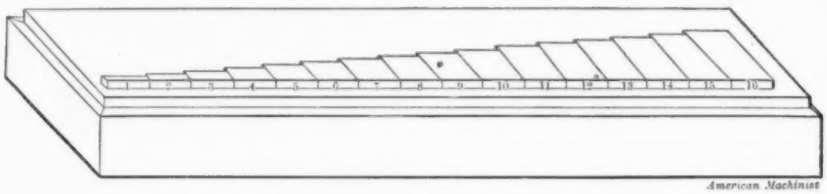


FIG. 1. SIZE-BLOCK CASE WITH COVER REMOVED

The sketch, Fig. 1, shows a 16-piece set of measuring blocks, from 1/16 to 1 inch inclusive. The blocks are ¾x1¼ inches in area and their thicknesses range in sixteenths. They are placed on end in their cells in the case with about ¼ inch of their length protruding, and directly in front of each piece its dimension is plainly marked. This does away with trying to keep a set of distance blocks in the tool-box drawer and having to look the whole lot over to get the right one. If any one of the 16 blocks in Fig. 1 is desired, one has only to pull out the piece from the cell which is marked with the corresponding number.

The "block house," as we call it, is very simple. The body is made in two pieces, one piece being notched in, in sixteenths and butted up against its mate. In other respects it is similar to a common oil-stone case, with the exception of the cover, which is dug out to fit over the group of blocks.

There is scarcely a machine in the shop where this set of measuring pieces could not be used to advantage. Most machinists have nearly a full set up to 1 inch, but in nearly all cases one or more pieces have been lost on account of not having a "case" for them.

The hight gage shown in Fig. 2, is a companion to the set of size blocks in Fig. 1, and is one of the handiest tools that a shaper man or a man operating a small planer ever had about his kit. The opening jaw under the gage rod or wire admits any desired block and the rod is dropped on to it and clamped. Thus, with one wire 16 different hights may be obtained by the use of the block system. With the high gage supplied with a set of wires ranging from 2 to 8 inches and the 16 size blocks one is well equipped for getting the different hights required and no time is lost in borrowing gaging devices from other workmen. The hight gage, when made of annealed tool steel and polished, makes a very neat tool.

Albany, N. Y. J. O. BLACK.

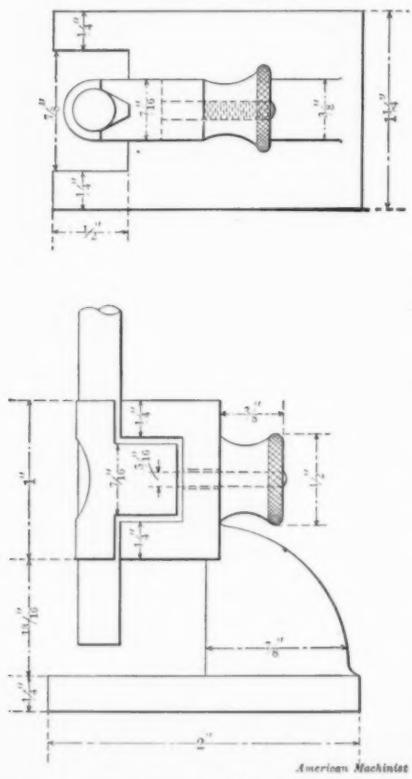


FIG. 2. HIGHT GAGE

Shall We Use a "No Finish" Sign?

To the readers of the AMERICAN MACHINIST, in particular engineers and draftsman, my object is to bring up for discussion the question of the universal adoption of a "no finish" sign. It occurs time and again that a piece has to be finished all over except one spot, and it has often struck me as useless to add a lot of finish signs, especially on small work. You could just as well say "finish all over" with a "no finish" sign added so as to guard the patternmaker and machinist from overlooking it.

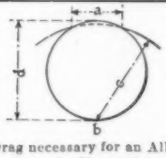
Chicago, Ill. C. G. KRANZ.

Drag of Calipers in Making Allowances for Fits

The accompanying table gives the amount of "drag" of outside calipers or "rock" for inside calipers necessary for a given allowance. Just below each value of *a* is its value to the nearest 64th. It is, of course, understood that one point of the caliper is held stationary at *b* while the other describes an arc.

For example, we have to make a forced fit for which we consider 0.002 inch the proper allowance: In the column headed 0.002 and opposite the diameter 4 inches, we find 0.2528, practically ¼ inch, as the distance the calipers should drag, they having previously been set to the exact diameter of the hole.

For boring a hole, the same allowance can be obtained by the reverse of the above, i.e., setting the calipers to the shaft so that they drag the given amount and boring the hole the exact size of the calipers. It is evident that if inside calipers are allowed to rock in the hole the



a is Drag necessary for an Allowance of d—c above the Nominal Diameter c.

Drag of Calipers for Different Allowances in Inches.

Diam. Ins.	0.001	0.002	0.003	0.004
1.0	0.0895 3/32−	0.1265 1/8	0.1548 5/32	0.1787 11/64+
1.5	0.1095 7/64	0.1548 5/32	0.1898 3/16	0.2288 15/64−
2.0	0.1262 1/8	0.1782 11/64+	0.2190 7/32	0.2530 1/4+
2.5	0.1413 9/64	0.2000 13/64	0.2450 1/4−	0.2827 9/32
3.0	0.1551 5/32	0.2190 7/32	0.2679 17/64	0.3096 5/16
3.5	0.1672 11/64−	0.2366 15/64	0.2898 19/64−	0.3346 21/64+
4.0	0.1792 11/64+	0.2528 1/4+	0.3099 5/16−	0.3573 23/64
4.5	0.1898 3/16	0.2683 17/64+	0.3285 21/64	0.3794 3/8−
5.0	0.2001 13/64−	0.2825 9/32	0.3465 11/32	0.3999 13/32+

American Machinist

DRAG OF CALIPERS IN MAKING ALLOWANCES FOR FITS

same amount, the allowance will be above the size of the calipers, for a slipping or running fit.

Blacksburg, Va. W. C. DIXON.

Design of Ball Thrust Bearings

In ball or roller bearings for end-thrust it is quite customary to form one race with a spherical surface, or interpose a spherically formed washer between one of the races and the casing which surrounds the bearing. The avowed purpose of this construction is to gain an equal distribution of the thrust on all the balls in the bearing by permitting one of the races to adjust itself automatically

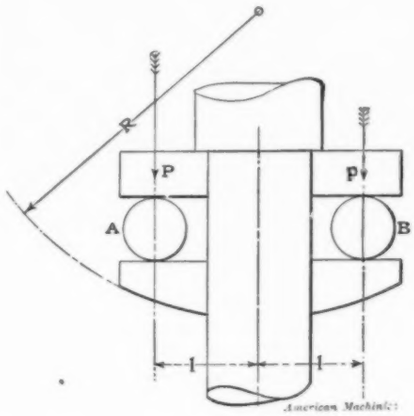


DIAGRAM ILLUSTRATING FORCES ACTING ON A BALL-THRUST SPHERICAL WASHER

on a spherical seat. If the radius of the spherical seat is relatively *small*, the purpose will be practically gained sometimes, but with a relatively *great* radius the extent of the automatic adjustment of the race will not prevent a considerable difference in the loads on oppositely located balls.

This will be clear from the acompanying figure, in which R denotes the radius of the spherical seat, L the distance between the ball and the center line of the shaft, P the load on the ball A, p the load on the ball B, and f the coefficient of friction. The couple $(P-p)\,L$ tending to rotate the spherical race in one direction is opposed by the frictional force $(P+p)f$ acting on a lever arm R. Consequently $(P-p)L=(P+p)fR$. It is quite usual that $\frac{R}{L}=3$ and f may be taken to $\frac{2}{10}$. We then have $P-p=(P+p)\times\frac{6}{10}$ and if we assume the load on the bearing to be, say, $P+p=1000$ pounds we get a difference of 600 pounds between the load on the ball A, and the load on the ball B. Or in other words the spherical race will not automatically adjust itself further than to permit a load of 800 pounds on the ball A, and a load of 200 pounds on the ball B.

In case R is greater than 3 times L, the difference in the loads on the balls A and B will be still greater. It is frequently observed in ball bearings after they have been in service for some time that the races, although provided with a spherical seat, are worn by the balls to a groove which is much deeper on one side than on the other, indicating that one side of the bearing received a heavier load than the other one. As pointed out in the AMERICAN MACHINIST, Volume 31, page 20, Part 1, the balls in a ball bearing may sometimes be subjected to worse conditions than above described, and it may even happen that a single ball may have to sustain the entire load, irrespective of the number of the balls. An appreciation of this fact has led to the adoption of a type of ball bearing designed purposely so, that each one of the balls shall be able to support with a proper safety factor, the whole load acting on the bearing. GUSTAF RENNERFELT.

Karlstad, Sweden.

Precision Squares

Gage work in gun shops requires tools of the highest degree of accuracy, and

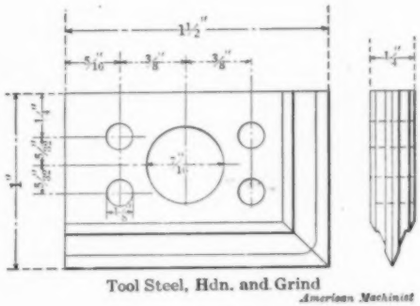


FIG. 1. SMALL PRECISION SQUARE

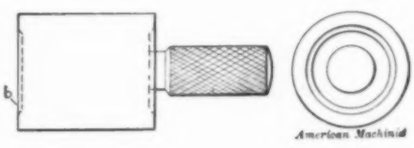


FIG. 2. MASTER SQUARE

perhaps the sketch in Fig. 1 of a small precision square used by gage makers may be of interest.

It is made of Jessop's tool steel and after machining is pack-hardened and rough ground, then laid away to season for two or three months, again taken in hand and finish ground, and after seasoning, is lapped on all sides to the master square, which is shown in Fig. 2.

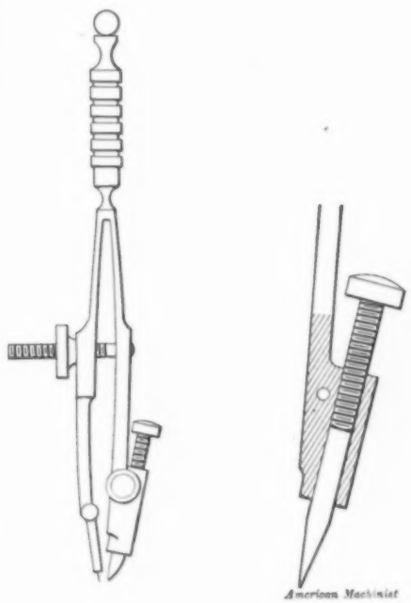
As will be seen, this is a block of tool steel, having a handle at one end. After hardening, the block is allowed to season and is roughed out on the grinder several times, being allowed to season between grindings. It is finally ground to a finish, care being taken to get a smooth and parallel surface and to have end b ground at right angles to the surface at the same setting. If necessary it is then lapped and thoroughly tested to correct the errors, until finally passed for use as a master gage for testing squares.

Greenfield, Mass. F. C. SCRIBNER.

Pencil Adjuster for Spring Bow Compass

Having to make a large number of small circles with a soft pencil, I experienced trouble through the pencil point wearing down rapidly, necessitating frequent adjustment, which at the same time alters the radius. I devised the following method which enabled me to put a fine feed on the pencil.

The hole in which the pencil was held, was tapped about half way down and the screw with the thumb disk was fitted as shown in the sketch. The tapping was done with the jaws clamped together, thus preventing the feed screw from being gripped too much when the pencil was held. To feed the pencil, the gripping screw was slackened, the pencil pressed forward by the thumb screw and then tightened up again.



PENCIL ADJUSTER FOR SPRING-BOW COMPASS

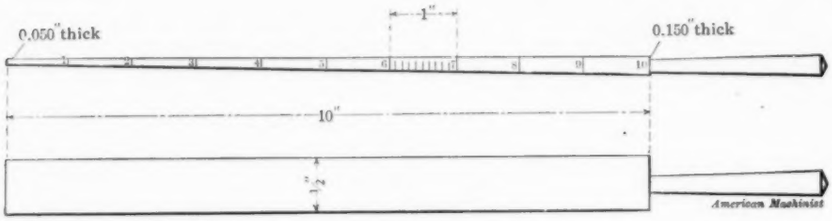
Anyone making circles up to ⅛ inch radius will know the disadvantage of the point being a shade too short or too long and will appreciate this improvement, which by the way, I have not patented.

E. M. SENYOUR.

Manchester, England.

A Useful Thickness Gage

Machinists are familiar with the thickness gages of wedge-like form, graduated on both sides, in thousandths and millimeters, respectively. I have found the gage shown in the sketch of great service for various purposes in the erecting shop, especially for setting armatures



A USEFUL THICKNESS GAGE

concentrically with their pole pieces, and for this purpose there is no better tool, it being far superior to the thin wood wedge now in vogue in many shops.

The flat part of the wedge gage is precisely 10 inches long, while a handle is turned on the thick end for use when applying it. It is 0.050 inch thick at the thin end and 0.150 at the thick end, and is divided (on the parallel edges) into 10 parts of 1 inch each. The 10 inches are then divided each into 10 parts.

The total taper of the gage being the difference between 0.050 and 0.150 inch equalling 0.100 inch, the difference in thickness between a 1-inch mark and the next one is 0.01 inch, and the difference in thickness between one 1/10-inch mark and the next is, obviously, 0.001 inch.

Silvertown, Eng. J. T. TOWLSON.

Laying Off Tools for Bolt Headers

In the accompanying illustrations are shown some tools used in the laying off squares and hexagons for making bolt-heading dies for bolt machines. The bolt header is a piece turned in the lathe and the inside circle represents the hole whose diameter is the width wanted across the flats.

The laying-off tool is in two parts, the main body being a centering square and the other part being shaped to fit two faces of the square or hex. The two parts are held together with nurled screw and the slot allows for the required adjustment, after which the square or hex is scribed on the work. There is sufficient adjustment to allow for bolt heads from ¼ inch to 2½ inches.

Formerly this work was done by driving in a wood center and dividing this into 4 or 6 parts, requiring considerable time for each operation.

While designed for this particular class of work, many of your readers will no doubt find it useful for other purposes.

J. S. DUPÉRÉ

Maisonneuve, Canada.

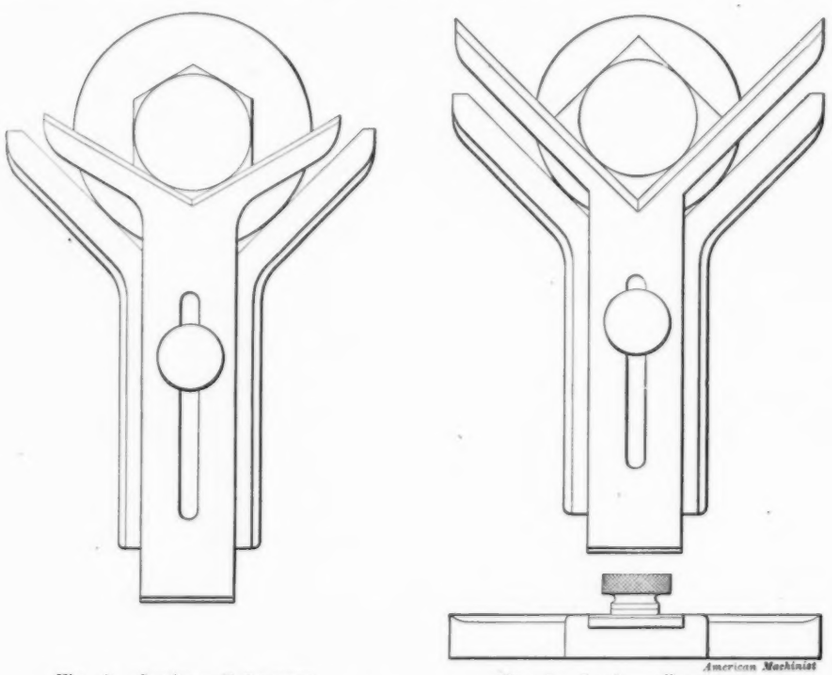


Fig. 1. Laying off hexagon. Fig. 2. Laying off square.

LAYING OFF TOOLS FOR BOLT HEADERS.

Ball Bearings Applied to Old Drill Presses

Figs. 1 and 2 show a ready method of increasing the efficiency and output of many an old drilling machine by simply replacing the thrust collars (Fig. 2) under the feed screw, by a ball bearing, as in Fig. 1.

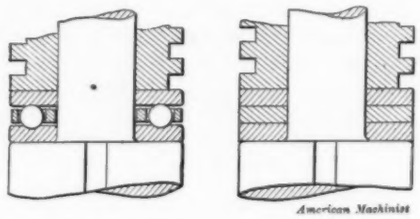


FIG. 1. APPLICATION OF BALL BEARING TO DRILL SPINDLE

FIG. 2. ORDINARY THRUST COLLARS TO BE REPLACED BY DRILL BEARING

The ease with which the above change is made must appeal to many of your readers who are attempting to get greater output from existing machines by using high-speed drills but who find, as I have, the limiting feature to be belt power.

Leeds. J. M.

Cutting an Oil Groove with a Drill

The fixture illustrated in the halftone Fig. 1, and line section, Fig. 2, is used to cut oil grooves with a small drill.

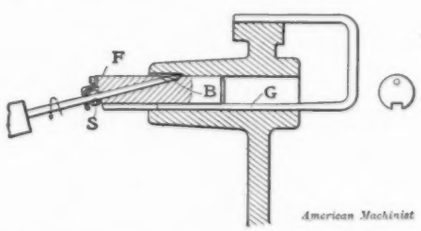


FIG. 2. SECTION OF FIXTURE TO CUT OIL GROOVES WITH A DRILL

FIG. 1. FIXTURE TO CUT OIL GROOVES WITH A DRILL

Referring to Fig. 2, *G* is a straight key clamped into position and serving to guide a piece *F* that fits the hole being grooved, and this in turn guides the drill as shown. At *S* is a stop on the drill, determining how far the drill projects through *F* and thus the depth of the oil groove. The stop also pushes along the guide *F* as the drill advances.

The drill can be driven by a pneumatic, electric, or hand-drilling machine, as the case may be.

The device has been thoroughly tested and proved to be satisfactory.

MATH. HASS.

St. Georgen (Schwartzwald), Germany.

Weight of Steel Bars and Flat Stock

Having, on several occasions, to figure the weights of various parts and finding the tables giving the weights of material per linear foot inconvenient, especially where drawing dimensions are given in inches, I have reduced the tables for steel, giving the weight per linear inch, and submit them for the benefit of readers who may be situated as I was when I prepared the tables.

Greenfield, Mass. F. C. SCRIBNER.

Correcting for Arbor Size in Winding Springs

Very often, when making springs of particular diameter, inside or out, the practice is followed of experimenting on a short spring until the required arbor is obtained, the failure being pitched into the pink box. A little piece of wire will save the spring and some time.

If, after making the spring to the nearest guess, it opens out too large, bend double a piece of suitable-sized wire, and fasten the two ends in the tool post. Pass two or three turns of the spring through the loop thus formed and grip them in the chuck, using a smaller arbor than before. Draw the wire taut, and remake spring. This is shown in Fig. 1.

When a small spring requires to be enlarged, use an arbor which is as good a fit as is handy. Start a coil of the spring through the loop at the end nearest the tailstock, and then turn it all carefully through. This is shown in Fig. 2.

The required diameter is secured in this case by the distance of the loop from the arbor, which can be regulated with the cross-slide.

Middletown, Conn. J. H. B.

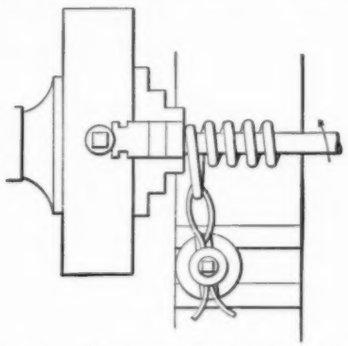


FIG. 1. REDUCING DIAMETER OF SPRING

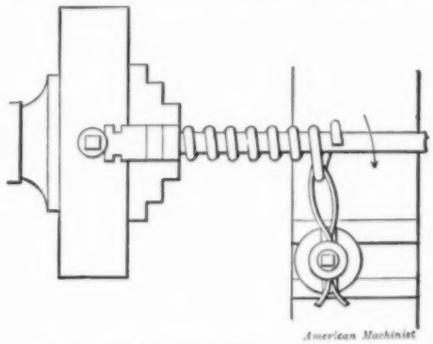


FIG. 2. INCREASING DIAMETER OF SPRING

WEIGHT OF FLAT STEEL IN POUNDS PER LINEAR INCH.

	1/2	5/8	3/4	7/8	1	1 1/8	1 1/4	1 3/8	1 1/2	1 5/8	1 3/4	2	2 1/4	2 1/2	2 3/4	3	3 1/2	4	5	6
1/16	0.017	0.022	0.026	0.031	0.035	0.039	0.044	0.048	0.053	0.062	0.070	0.079	0.089	0.098	0.106	0.124	0.141	0.177	0.213
1/8	0.026	0.033	0.040	0.046	0.053	0.059	0.065	0.073	0.080	0.093	0.106	0.119	0.133	0.146	0.160	0.186	0.212	0.266	0.319
3/16	0.035	0.044	0.053	0.062	0.071	0.079	0.089	0.097	0.106	0.124	0.141	0.159	0.177	0.195	0.213	0.248	0.283	0.355	0.425
1/4	0.044	0.055	0.066	0.077	0.088	0.100	0.110	0.121	0.133	0.155	0.177	0.199	0.221	0.243	0.265	0.310	0.354	0.443	0.531
5/16	0.053	0.066	0.080	0.093	0.106	0.120	0.132	0.145	0.159	0.185	0.212	0.239	0.266	0.292	0.319	0.371	0.425	0.533	0.638
3/8	0.062	0.077	0.093	0.108	0.124	0.140	0.155	0.170	0.185	0.216	0.248	0.279	0.310	0.340	0.371	0.434	0.495	0.620	0.743
7/16		0.089	0.106	0.124	0.141	0.160	0.177	0.195	0.212	0.248	0.283	0.319	0.355	0.390	0.425	0.496	0.566	0.710	0.850
1/2		0.100	0.120	0.140	0.160	0.180	0.190	0.219	0.240	0.279	0.319	0.358	0.398	0.438	0.478	0.557	0.637	0.796	0.958
9/16			0.133	0.155	0.176	0.200	0.221	0.243	0.265	0.310	0.355	0.399	0.443	0.488	0.532	0.620	0.710	0.886	1.065
5/8			0.146	0.170	0.195	0.220	0.243	0.268	0.292	0.340	0.390	0.438	0.486	0.535	0.584	0.681	0.779	0.975	1.166
11/16				0.186	0.212	0.238	0.265	0.291	0.316	0.371	0.425	0.478	0.533	0.585	0.637	0.743	0.850	1.066	1.275
3/4				0.200	0.230	0.260	0.287	0.316	0.345	0.402	0.460	0.518	0.575	0.633	0.690	0.805	0.925	1.150	1.383
13/16					0.250	0.278	0.310	0.340	0.371	0.434	0.496	0.558	0.621	0.682	0.745	0.868	0.993	1.243	1.490
7/8					0.265	0.299	0.331	0.365	0.398	0.465	0.531	0.597	0.664	0.730	0.796	0.933	1.066	1.325	1.591
1						0.318	0.354	0.390	0.425	0.495	0.566	0.638	0.710	0.780	0.850	0.993	1.133	1.42	1.70
1 1/8							0.398	0.439	0.478	0.559	0.637	0.717	0.799	0.878	0.956	1.117	1.275	1.597	1.912
1 1/4								0.487	0.531	0.620	0.708	0.797	0.887	0.985	1.063	1.241	1.416	1.775	2.134
1 1/2								0.585	0.638	0.745	0.850	0.957	1.065	1.180	1.275	1.490	1.700	2.130	2.500

TABLE II. WEIGHT OF FLAT SIZES OF STEEL.

WEIGHT OF STEEL BARS IN POUNDS PER LINEAR INCH.

Diameter or Distance Across Flats.	Round.	Square.	Hex.	Oct.	Diameter or Distance Across Flats.	Round.	Square.	Hex.	Oct.
1/16	0.001	0.001	0.001	0.001	1 1/16	0.634	0.806	0.698	0.668
1/8	0.003	0.004	0.004	0.003	1 1/8	0.681	0.867	0.752	0.719
3/16	0.008	0.009	0.008	0.008	1 3/16	0.731	0.930	0.806	0.772
1/4	0.014	0.017	0.015	0.015	1 1/4	0.782	0.995	0.863	0.826
5/16	0.022	0.027	0.024	0.023	1 5/16	0.835	1.063	0.921	0.881
3/8	0.031	0.040	0.034	0.033	1 3/8	0.890	1.133	0.982	0.940
7/16	0.042	0.054	0.047	0.045	1 7/16	1.005	1.279	1.109	1.060
1/2	0.055	0.070	0.061	0.059	1 1/2	1.126	1.435	1.243	1.186
9/16	0.070	0.089	0.077	0.074	1 9/16	1.255	1.598	1.385	1.323
5/8	0.087	0.110	0.095	0.092	1 5/8	1.390	1.770	1.535	1.470
11/16	0.105	0.134	0.116	0.110	1 11/16	1.533	1.952	1.692	1.620
3/4	0.125	0.159	0.138	0.132	1 3/4	1.683	2.142	1.857	1.773
13/16	0.147	0.187	0.162	0.155	1 13/16	1.839	2.341	2.030	1.940
7/8	0.170	0.217	0.188	0.179	1 7/8	2.002	2.550	2.210	2.113
15/16	0.195	0.249	0.215	0.206	1 15/16	2.173	2.766	2.398	2.291
1	0.222	0.283	0.245	0.235	2	2.350	2.993	2.591	2.440
1 1/16	0.251	0.319	0.277	0.265	2 1/16	2.535	3.231	2.797	2.675
1 1/8	0.281	0.358	0.310	0.297	2 1/8	2.726	3.470	3.008	2.880
1 3/16	0.314	0.399	0.346	0.331	2 3/16	2.924	3.715	3.227	3.087
1 1/4	0.347	0.442	0.383	0.367	2 1/4	3.130	3.985	3.454	3.306
1 5/16	0.383	0.488	0.423	0.405	2 5/16	3.341	4.254	3.688	3.530
1 3/8	0.421	0.535	0.464	0.444	2 3/8	3.560	4.533	3.930	3.760
1 7/16	0.460	0.585	0.507	0.485					
1 1/2	0.506	0.637	0.552	0.528					
1 9/16	0.543	0.691	0.599	0.575					
1 5/8	0.587	0.748	0.648	0.620					

TABLE I. WEIGHT OF STEEL BARS.

Application of Lifting Magnets

An interesting application of large lifting magnets has taken place near New Orleans where a barge of kegged nails has been raised from the bed of the Mississippi river by this means. A reported saving of 85 to 95 per cent. is effected by this method, which could not be otherwise accomplished. Were a dredge used, kegs would be broken open, and much valuable material lost. In this way, the kegs are raised intact, and the nails are uninjured except for slight rust.

Discussion *of the* Previous Question

Letters from Our Readers Showing how many Men of many Minds Look upon Various Subjects Opened up in previous Numbers

Cutting Coarse Pitch Threads

Reading on page 204, of a triple-thread worm cut at Messrs. James Bertram & Sons, at Dundas, Ontario, Canada, reminded me of a similar pitch I cut some years ago. Instead of having three starts or leads, I cut sixty; they were a pair of rolls for a screw-rolling machine of the cylindrical type, made by Messrs. Nettlefolds, Birmingham, England, and cut on a ¼-inch pitch lathe, or a lathe with a lead screw 4 threads per inch; the wheels to produce this pitch are 120 mandrel, 15 stud, 100 stud pinion into 20 leading screw; of course, it was impossible to cut the thread by driving off the spindle, so I forged a wrought-iron handle, then drilled and tapped the end of the leading screw, and bolted the handle to it, which I turned with the greatest ease. The rolls were about 4 1/16 inches diameter and about ⅜ inch thick.

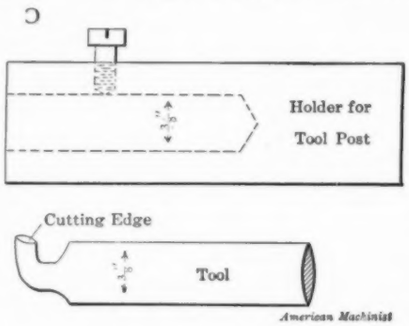
The method I generally use for calculating coarse pitches is the rule of ten teeth to cut ⅛ inch; the leading screw in this case being ¼-inch pitch, or 4 threads per inch, required a wheel with twenty teeth in the leading screw; as ten teeth cut ⅛ inch, twenty teeth must cut ¼ inch and in 10 inches in length I should have 80 one-eighths, which would work one eight hundred teeth; 800 divided by 8 equals 100, which would be the wheel for the stud pinion. Now I should have two more wheels, one to rotate eight times while the other rotates once, hence, 120 on the spindle into 15 on the stud; wheels required 120 spindle, 15 stud, 100 stud pinion, 20 leading screw; 15 into 120 goes 8 times, and 20 into 100 goes 5 times, and 8 times 5 equals 40, which would be the number of times for the leading screw to revolve. Being ¼-inch pitch, and revolving forty times, would be eighty one-eighth inches, the required pitch.

After getting the wheels fixed in their respective places, I proceeded to divide the 120 wheel into sixty divisions, also marking off the intermediate wheels and the wheel on the leading screw, so as to insure the exact position of starting, then I proceeded to cut the first lead, after cutting to the required depth, I again got the wheels into the zero or starting position, when I drew out the intermediate wheels, taking great care not to disturb the leading screw wheel, and then pulled the lathe spindle round until the next line on the 120 wheel came in line with the intermediate wheels, which I pushed into position and started to cut the next lead, proceeding as before until the whole sixty leads were complete.

Urbana, Ohio. WALTER J. ILES.

Round Nose Tool for Ball Races

Seeing an account of a round-nose tool for ball races on page 142 reminds me of a very neat device used by a turner I once came in contact with. He had a lot of ball races to make; in sizes of ⅛, 3/16 and ¼ inch. The method he employed was to get a piece of common steel to fit his tool post and drill a ⅜-inch hole, 1½ inches long, into the end of it. Then he turned 3 pieces of ⅜-inch silver-steel down to ⅛, 3/16 and ¼ inch respectively, as far along as was necessary to obtain sufficient bend. After heating them, he bent the end up, as per sketch, then hardened and ground them and fastened them in the holder he had drilled to fit, by a set screw.



TOOL FOR BALL RACES

This made a most satisfactory job, as every ball race was exact. He did not have to stop to use a gage, after he had once got the right depth by the graduated collar on the cross-feed screw. A great advantage of this tool is that it can be used for both external and internal work.

GEO. WHITWORTH.

Birmingham, Eng.

Semi-Automatic Sheet Metal Trimming Lathe

At page 161 appears a description of a semi-automatic trimming lathe by W. W. Patterson.

There are one or two points about the machine which are not quite clear to me. The first thing that strikes one is the number of shells trimmed in a day, of ten hours, I suppose. To turn off the number given, I should have thought, judging from experience, that he would have needed a multi-spindle machine.

Our firm has a semi-automatic trimming machine which has a travel sufficient to admit a shell ¾ inch deep, yet it only produces 21,000 in a day of nine hours, and the operator is kept busy feeding it by means of a chute.

Now suppose Mr. Patterson is trimming shells 3½ inches deep, that means his follower shaft will have to travel about 3¾ inches to admit an untrimmed shell and to do the number stated. I imagine there is going to be some jarring, also some wear and tear on the cam, etc. I take it for granted that when the shell is trimmed, it comes back into the shuttle, and falls through the opening, which at that point is at the bottom. Another point that is not quite clear, is how he gets the scrap away without its getting into the groove cut in the arbor to form the cutting edge.

Also, the trimming wheel is at such a keen angle, that I should be afraid it would not keep its edge for long. The shedder is all right for shells that are simply trimmed, but can he suggest how he would overcome the difficulty if the shells had to be beaded and trimmed at one operation? I like the shuttle idea, as this reduces the travel to the length of the shell.

J. A. LUPTON.

Nottingham, England.

Checking of Steel Tools

C. U. Scott, whose article appears on page 222 of the AMERICAN MACHINIST, wants to know what causes checking in fine finishing steel tools. While making some inquiries in his behalf, I have been reliably informed by an expert hardener, with special facilities for observation, that the checking referred to is due to improper grinding; that is, the operator heating the steel sufficiently to cause surface expansion.

We have had the same trouble here until this was discovered. The checking occurs in the heavier work only, and we think this corresponds with Mr. Scott's experience, since he says that he invariably finds that milling cutters four inches or more in diameter return from the grinding department checked. We have had some plates of Jessop steel 10 inches square and 1¼ inches thick which were known to have been hardened successfully, but were returned from the grinding department checked.

Checking has also occurred in some fine-edged tools which we make. Although the grinding operators and others claimed it to be due to the hardening, it was finally brought to a test and found to have been done in the grinding. The operators were simply instructed to exercise more care which they did, and no more trouble followed.

The workman grinding these fine edged tools informed me that he can warp one all out of shape by overheating in grinding. This is probably the cause of Mr. Scott's tools springing out of center 0.03 inch.

Doubtless those tools that were found soft were ground so, the friction counteracting and overcoming the water effect on the work. This can be done without any display of color as the presence of the water excludes the air, consequently the steel cannot oxidize.

Elgin, Ill. GUS HAESSLER.

Grinding High-speed Twist Drills

I should like to give you my experience in grinding high-speed drills and turning tools. In one shop I was in four years ago we used a Gisholt tool grinder to dress the lathe and planer tools after being forged and hardened. The steel used was A. W., in sizes ¾ inch to 1½ inches, and Huntsman's Ajax 1½ inches square. When we began we used a plentiful supply of water and the usual wheel supplied with the machines, which is a very coarse one made by the Norton Company. Cracks occurred all over the surface and it was suggested that the effect of hardening the steel caused it to crack, and that we rough them out first and harden afterward. This did not improve matters. I may say that we forced the work along pretty well as hard as the machine would go for certain reasons.

The consequence was they fell in with my suggestion that we grind dry, as I pointed out that we could not expect to grind high-speed drills till the surface was a dull red at each jerk of the cut and pour cold water on it, as this was entirely contrary to the maker's directions of keeping the steel, while hot away from all water. Our trouble with cracks ceased. Of course, our wheel wore away very much faster and we had to go slower.

At another place where I was we used "Novo" and a Seller's grinder with water, but we had no cracks; although the wheel was not nearly so coarse it has always been my private opinion that the result was a painfully slow progress.

Now as to grinding twist drills; we found the same trouble with cracks when using water if we tried to do too much at a stroke, but the water kept the wheel in a better and keener condition and produced better results than dry grinding. Of course, there is a good deal of difference between a forged lathe tool and a dull twist drill in point of metal required to be removed to give similar finishing effects.

There can be no doubt that wet grinding is much healthier for the operator.

I have not since had any reasons for altering the opinion formed then.

Manchester, England. M. J. B.

Adjusting Two Motors to Drive One Shaft

On page 157 O. S. Bickford, relates his experience of driving a single line shaft by means of two motors, but omits to state the type of motor employed. Mr. Bickford has certainly been fortunate in not having any troubles develop, but this may be due to the small size of motors. However that may be, I am certain that a careful investigation will show that the two motors are not sharing their loads in proportion to their ratings unless special arrangements have been made to effect this.

The motors which are most likely to be used in machine shops are either the three-phase induction motors with or without slip rings, or the direct-current shunt-wound motor perhaps slightly compounded. With either type of motor, the following holds good for all practical purposes:

When running light these motors attain their maximum steady speed, and this speed will decrease as the motors are called upon to do useful work. At full load, with such small motors, the speed may be as much as 10 per cent. below the free-running speed, but for equal free-running speeds, the three-horse motor will have a higher full-load speed than the two-horse motor would have at its full load.

From this it follows that when the three-horse motor is developing three horsepower, and if the motors are belted so as to run at equal speeds, the two-horse motor has not slowed down sufficiently to allow it to develop two horsepower. Further—when the two-horse motor *has* been slowed down until it develops its full load, then the three-horse motor is developing more than three horsepower and is overloaded. This is a state of affairs that can very readily arise when two dissimilar motors are coupled to one machine or one line shaft, and when the motors are of any great size, it assumes a serious aspect, calling for careful consideration.

With direct-current motors, such trouble is readily avoided by providing a field rheostat in the shunt field of each motor, and an ammeter in the armature circuit of each motor. An inspection of the meters will show how the loads are divided, and the division may be made correct by an adjustment of one or the other of the rheostats.

When induction motors are used the problem becomes somewhat more difficult of solution if the loads are to be divided quite correctly. The manufacturers of the motors can give the figures relating to the drop in speed from zero to full load for each motor. From these figures the ratios of the belt pulleys, or other gear between each motor and line shaft, are calculated so that when the power on the shaft is equal to the aggregate of the two motors, then each motor runs at its own full-load speed. This will necessitate pulleys or gears of odd dimensions, yet it is necessary if neither motor is to be overloaded. The ratios must be carefully figured out, for a difference of only 1 per cent. in the full-load speed of either motor will make a difference in the power developed of about 15 per cent. in very small motors, up to 30 per cent. in motors of, say, 100-brake-horsepower capacity and even more with the larger motors that are now being made by the electrical manufacturers.

The preceding remarks apply whether two or more motors drive a common shaft.

Where the motors have different free-running speeds this has to be taken into account in determining the belt or gear ratio required.

This point of proper division of load between electric motors driving a common shaft is frequently neglected—to the detriment of the motor.

Manchester, England. MINER.

"A Tool Post Wrench"

When first I saw the idea illustrated by John E. Sweet on page 269, I thought it very good.

Since then, however, I have set out several sizes of our standard screw-heads and find that the device is scarcely feasible on any square-head screws below 7/16 inch.

Square heads are not made with sharp corners and further there must be about 0.005 to 0.01 inch of slack on the flats.

Taking these two factors into account it will be seen that, especially on the small sizes, there will be very little metal on the spanner to be wedged away before one could simply rotate it on the screw-head. J. H. JOHNSON.

Coventry, England.

As the result of tests made in the mechanical laboratory of Worcester Polytechnic Institute for ascertaining the relative thermal conductivity of rolled copper and that not rolled but deposited by electrolysis, it was found that rolled copper exceeded electrolytic copper by 30 per cent. in conductivity. Change brought about in the internal structure of metals by mechanical treatment is thus interestingly shown.

Apprenticeship Systems in Railroad Shops

*By J. M. Hamm**

There is a diversity of opinion in regard to the practicability of the present apprenticeship courses. The question arises as to what use will be made of the apprentice after he has finished his course of apprenticeship. Some say that they expect some of them to be future S. M. P's. Will they ever get a chance? Are not S. M. P's. developed at colleges at the present time.

The fact in the case is that the future machinist, speaking in a general way, will be used on some special job.

The Starting Point

The erecting department is where all work is assembled, consequently all repair work is started and completed on the erecting floor, this floor being the starting point or foundation. Let us go into details and find out what use we have for a machinist inasmuch as it is probable that the following specialized system will prevail in every modern shop in the United States.

The first operation is to dismantle all parts to be repaired. This is done by handy men who have been trained for the work and who are known as the stripping gang.

The next operation is the distribution of material to the various departments. The work is assembled under the jurisdiction of a man who is known as the gang foreman. He has charge of 12 pits and has his men grouped in the following gangs: Cylinder and frame gang; pedestal, gib and wedge gang; top-work gang; dry-pipe gang; motion gang; steam-chest gang; guide gang; brake-rigging gang; reaming gang; rod gang; valve-seat facing and cylinder-boring gang.

Duties of the Different Gangs

The cylinder and frame gang assembles frames and cylinders, applies frame braces, waist sheets, tail bars and applies bolts to these parts. The pedestal shoe and wedge gang repairs stay plates, fits up shoes and wedges, applies driving boxes and wheels the engines. The top-work gang applies all running boards, sand boxes, bells and boiler fronts. The dry-pipe gang consists of handy men specially trained for the grinding and application of steam pipes, dry pipes, stand pipes, throttle boxes, dome caps and exhausts.

The motion-work gang applies all motion work to the engines, including rocker-boxes, reverse shafts and links, and attends to the setting of the valves and all details. The steam-chest gang assembles steam chests and the contents thereof. The guide gang assembles all guides, applies pistons and cylinder heads. Cylinder reboring and valve-seat facing are all done by one set of men. The rod gang applies all connecting rods. The brake-rigging gang fits up and applies all valve rigging, this gang being composed of handy men trained for this special work. There is also a reaming gang who ream all holes, this gang consisting of men specially trained for this service.

Specialization in Machine Operation

Taking up the question of machining the various parts, we find the machine foreman has the work specialized in the following manner: Every machine has a certain piece to handle and the respective tools are known by the names of the parts which they machine; thus we have the cylinder planer, frame planer, shoe and wedge planer, frame-brace planer, pressure-plate and steam-chest planer, driving-box planer, driving-axle lathe, crank-pin lathe, motion-work lathe, rod-brass shaper, and so on right through every job that is done on an engine. The laying out of work is done by one set of men; we also find a driving-box gang that repairs driving boxes, fitting them ready for application to the axles, and a cylinder and frame gang fitting up new repair parts.

We might go into detail with all specialized work, referring, for example, to the air rod, and motion-work gangs; however, it has been clearly pointed out that a foreman has no place to use a man who knows a little of everything and not much of anything. The same can be said of the boiler, blacksmith, tin and pipe departments.

The Kind of Men Wanted

Let me ask, are we not wasting the time of the boy and the railroad company? All that is wanted are men who can produce the maximum output of a given kind. As an illustration, if a gang foreman has a man who is successful at hanging guides, he will keep him on the job as long as he is in the service of the company. There is not a man living that can develop a thorough knowledge of a certain kind of work in four months; this is knowledge of a rudimentary character. For the sake of illustration, we will say that a boy has served his time, and what are called "hobo" machinists have filled the boy's mind with imaginary pictures of conditions in another shop. The boy resigns his position, and going to a strange shop he inquires for the general foreman's office and applies for work. The first question the general foreman will ask is, "What are you best at?" All that the boy can say is that he served his time in such a shop. Probably a man is wanted for the rod gang; the general foreman asks him how much rod experience he has had, and the boy answers "four months." The chances are that the boy will not get the job. However, had he been able to say that he was an expert planer hand he would probably have secured employment, thus demonstrating that an expert at a certain kind of work is what is wanted at the present time.

Many railroad shops in the country are located in towns made by the railroad companies where there is employment only in the shops, and after a man has worked for a term of years for a certain company it is rather uncharitable not to give employment to his boys. They should be tried out, and if found incompetent they should be transferred from one place to another until a place is found where they can be used advantageously. Why not cut the present apprentice courses in two and develop more desirable railroad employees?

*Machine foreman, Lehigh Valley shops, Sayre, Penn.

Improvement in Steel Rails

At the annual meeting of the American Railway Engineering and Maintenance-of-Way Association recently held in Chicago, a special report was presented calling attention to some of the changes in specifications which are necessary in order to secure good rails. The report recommends the maintenance of better relations between the carbon and the phosphorus and manganese, as the present practice results in rails that are soft and do not wear well. As a supplement to this, it is recommended that both minimum and maximum deflections under the drop tests should be provided in order to eliminate rails which are too hard (or brittle) and too soft respectively. It has not been determined as yet, however, what the limits should be. Furthermore, the committee points out that physical and chemical tests should be prescribed, and care taken to see that the material meets the requirements of these tests.

The report, among other things, states: The railways should not be asked to take anything but sound material in their rails. The mills can furnish such sound material if the proper care and sufficient time are taken in the making of the ingots. Information derived from the tests being made at the Watertown Arsenal shows definitely that sound rails cannot be made from unsound ingots, and that, therefore, the prime requisite in securing a sound rail is to first secure the sound ingot.

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Contents

PAGE

Automobile Building Details That Produce Good Results..... 621
A Swiss Fine Measuring Machine..... 626
Reminiscences of Fifty Years as an All-Round Mechanic..... 627
Oxygen, Hydrogen and Nitrogen in Steel 628
Convenient Assembling Stands for Automobile Engines..... 629
Special Tools and Methods Used in a Planer Building Shop..... 630
Unforeseen Difficulties in Starting a Shop 633
Plug and Templet Gage Dimensions..... 634
Long Fixtures and Gang Cutters on the Miller 635
A Few Special Tools Used in Building Radial Drills..... 637
The Passing of the Fitter..... 641
New Design of Steel Plate Edge Planing Machine 643
Development of Motors for Aëroplane Requirements 644
Some Uses of the Disk Grinder..... 647
Hydraulic Step Bearing for Index Table 648
Solution of a Difficult Conveyer Problem 649
Letters from Practical Men:
Size Blocks and Hight Gage....Shall We Use a "No Finish" Sign?....Drag of Calipers in Making Allowance for Fits....Design of Ball Thrust Bearings....Precision Squares....Pencil Adjuster for Spring Bow Compass....A Useful Thickness Gage....Laying Off Tools for Bolt Headers....Ball Bearings Applied to Old Drill Presses....Cutting an Oil Groove with a Drill....Weight of Steel Bars and Flat Stock....Correcting for Arbor Size in Winding Springs.....650-653
Discussion of the Previous Question:
Cutting Coarse Pitch Threads....Round Nose Tool for Ball Races....Semi-Automatic Sheet Metal Trimming Lathe....Checking of Steel Tools....Grinding High-speed Twist Drills....Adjusting Two Motors to Drive One Shaft...."A Tool Post Wrench" 654-655
Considerations in Buying Machine Tools 657
Preventing the Small Wastes..... 657
New Tools and Machine Shop Appliances 659

American Machinist

Editorial

Considerations in Buying Machine Tools

We frequently hear criticisms concerning the lack of coöperation between the mechanical and purchasing departments of shops when machine tools are to be ordered. It is said that the purchasing agent is interested only in price and delivery; frequently fails to consult with those in charge of production and often buys tools that are not well adapted for the work they are to perform. The presumption in all this is that if the purchasing agent and production superintendent did coöperate to the fullest extent every machine tool purchased would be exactly suited to its requirements and would become a money-maker from the day it was set up.

While such coöperation is advisable, indeed necessary, it does not follow that even such a combination can make the wisest selection of new machine equipment. Machinery is purchased on a supposition that it will earn; that it will make a profit, and the man ultimately responsible for dollars and cents is the one to finally decide as to the advisability or inadvisability of a given purchase.

The production department is primarily interested in quantity, quality and cost per piece of product. The purchasing agent is primarily interested in price and delivery of his purchases; but the manager is interested in the earning power of the plant. He must know that the new equipment will furnish its proper proportion of the total output at a profit, and, moreover, this profit must be in proportion to the volume.

The production department—especially in large shops—usually has only a hazy idea of what the profits of the business really are. It has accurate records of material and labor costs, but does not have any data in regard to the bearing of interest on investment, depreciation, value of floor space, cost of power, expense of supervision and the like, in fixing the total cost of the product. As these items in the aggregate usually equal, if they do not exceed, the direct labor costs, it is apparent that the production department from its own records cannot determine finally whether or not a given machine equipment has all of the necessary elements of a money-maker.

In fact, a judicious selection of a machine for a given class of work is probably more difficult than appears on the surface, with the advantage, in point of ease, in the shop that apportions its expense burden by the machine-rate method.

The prime consideration is, select the machine that will earn the largest profit; and this does not necessarily go hand in hand with the lowest labor cost per piece.

Preventing the Small Wastes

No thoughtful person can contemplate the subject of conserving, or preventing waste of natural resources without feeling that it is one of the most vital questions of the day, although in too many cases it has a vague, far away sound that does not appeal as strongly as it should. The failing of the natural gas in many sections is probably the most glaring example of our wastefulness of Nature's gifts and yet similar, though less spectacular wastes are still going on in many places all over the country.

The railroads of the country are credited with using about 95,000,000 tons of coal per year or approximately one-fifth of the total output and while we do not believe the locomotive is nearly as uneconomical a machine as some of our electrical friends try to prove, there is little doubt that some saving could be effected by more care in some directions and a saving of only 5 per cent. would mean 4,750,000 tons available for other work.

The saving or use of waterpowers in various sections will, if managed for the general good, afford cheap power and incidentally reduce or replace the consumption of coal to a considerable extent. But all these have a vagueness that does not come home to most of us, and it is much easier to preach and think of conservation for the other fellow than for ourselves.

Real conservation, like charity, should begin at home and though some of the things suggested here may seem small and insignificant, yet the aggregate is far larger than might be supposed.

Every cubic foot of gas or watt of electric current which is burned to no useful purpose is a waste of natural resources, coal in most cases. Every poorly lubricated or designed bearing that

requires more power than is necessary is likewise wasting energy which should be conserved if we are to be consistent in our demands.

True, it may seem cheaper in some cases, to pay for the extra power than to save it, still this is often a delusion that we fall into because it is easier than to get out of the rut and find a better way.

There are few boiler rooms that could not save at least a small percentage of the fuel used and pay for any change which might have to be made. But unless a loquacious salesman can convince us that his special device can save us 40 or 50 per cent., we are very apt to ignore a moderate saving and to entirely forget its effect on the total coal consumption of the country. Probably the kitchen range is the worst sinner in this respect, as it can give out fewer heat units that are useful, per pound of coal, than any other coal-using apparatus, yet it receives very little attention. Conservation in the larger matters of forests and water powers is to be highly commended, but we should not lose sight of the smaller ways in which we can help the good work along.

NEW PUBLICATIONS

THE UTILITY OF ALL KINDS OF HIGHER SCHOOLING. By B. T. Crane. 331 5¼x8-inch pages. A. C. McClurg & Company, Chicago, Ill. Price $1. net.

REVIEWED BY E. H. FISH

This book consists of a report of a publication by the same author in 1902 dealing with college education in general as the first part, and a second part dealing with the alleged uselessness of technical and other specialized education. Measured as a whole, it is a violent and vindictive attack upon everything above grammar grades in all of our school systems. Like many other similar outbreaks, this one appears to be the result of a misunderstanding. The author appears to consider, first, that man's sole duty and pleasure is to make money and, second, that educated men do not make money in quantities proportionate to the investment. Nevertheless, the book contains much that might be read with profit by those interested in technical schools, but it is, unfortunately, so intermingled with a mass of matter so entirely unreadable by such people that it will likely fail of having an effect.

The author apparently confuses the aims of a trade school with those of higher and more nearly professional schools. His statements as to what he expects a technical graduate to be able to do show that he is thinking of a skilled workman rather than of an engineer. Of the latter, few have taken up with purely manufacturing work, other fields being more congenial, even if not more lucrative. Of course, it is perfectly true that all of our older engineers and many of those of middle age, are non-technical graduates, for the simple reason that there was no opportunity for them to attend technical schools in their youth. The younger set are the men who are today doing things and solving problems far more difficult than those which he cites as the work of the older masters. To safely dig a cellar hole and erect a skyscraper in New York without tumbling the surrounding buildings into the hole, or to plan and design a power plant with its engines and turbines, is more difficult than the larger and more showy feats of the older men, which, most of them, were but small enlargements on previous efforts made safe by the cut-and-try method. A perusal of the catalog of any of the technical schools which publish the occupations of their graduates, will set at rest any fear that Mr. Crane judges them rightly. However lacking their training may have been, they have almost invariably fallen on their feet when brought face to face with the world. A single class as shown in a catalog before me, shows out of 13 living members, a mechanical engineer, a general auditor, a chief engineer and a vice-president, each of industries well up in the millions in rating and a manufacturer whose name is on every tongue among wood workers. The rest are well enough off to justify the cost of their training. Then too, according to Mr. Crane's own figures, his technical graduates gained $1000 per year each in a short time after graduating, this on an investment of $5000. A 20 per cent. investment looks good to me and I believe that it would to the author of this book.

The main question, however, is not whether a technical graduate can make money or not, but whether he has spent the time and money which his education has cost in a way that is advantageous to himself and the rest of the world along other lines as well. Is he thereby a better citizen? Is he a better father? A better neighbor? A better thinker? To these questions there is only one answer. A college man, a technical man, an educated man either school bred or home made, is a better, clearer thinker, a safer friend, a more generous enemy for his education and he is happier and brings far more happiness into this world.

Visitors vs. No Visitors

"I have no fear of competitors, anybody can go through our plant. Why! only a short time ago I showed the manager of the factory of our largest competitor all through the shop. I showed him everything, and when he was leaving he said: 'you are so far ahead of us in manufacturing methods that we cannot overtake you. It would take 10 years of work on our part to get where you are today.'"

There is a big truth behind this little incident, told by the manager of a big textile-machinery building shop. The up-todate shop usually opens its doors to visitors and has something worth while to show and to be seen. On the other hand, the shop with the sign or reputation "visitors not allowed" is usually not worth visiting, if one could be admitted.

Chicago Metal Trades Branch

The annual meeting and dinner of the Chicago branch of the National Metal Trades Association, was held in that city on the evening of March 22. Apart from the regular business and election of officers there were several addresses made including interesting discussions on the coöperative course for shop apprentices by George N. Carman, of the Lewis Institute; Employees' Insurance, by L. O. Chatfield; and Legislation—State and Federal, by William E. Mason. The following officers were elected for the ensuing year: President, John W. O'Leary; vice-president, W. L. Kroeschell; treasurer, L. C. Walker; secretary, Paul Blatchford.

PERSONALS

Items For This Column Are Solicited

M. Harrington, of Edwin Harrington Son & Company, Philadelphia, Penn., recently left for an extended Mediterranean trip and is at present sojourning in Italy.

F. X. Cleary, who has been connected with the Western Electric Company for about 20 years, having held important executive positions, has been appointed advertising manager of his company.

Joseph Perkins, for several years in charge of the Bowl department of the De Laval Separator Company at Poughkeepsie, N. Y., has resigned his position to accept the position of general foreman with Quincy, Manchester, Sargent Company, of Plainfield, N. J.

Walter M. McFarland, for the past 10 years acting vice-president of the Westinghouse Electric and Manufacturing Company, has resigned his position to become associated with the Babcock & Wilcox Company, New York City. Mr. McFarland has been a prominent figure in mechanical circles for a number of years, having been connected with the Bureau of Steam Engineering, and for two years was assistant professor of mechanical engineering at Cornell University. He has for a number of years been actively interested in the American Society of Mechanical Engineers and Society of Naval Architects and Marine Engineers, in both of which he has held important offices.

New Tools *and* Machine Shop Appliances
Showing New Ideas *in* Machine Shop Equipment *that* make *it* possible *to* do better work at a reduced cost

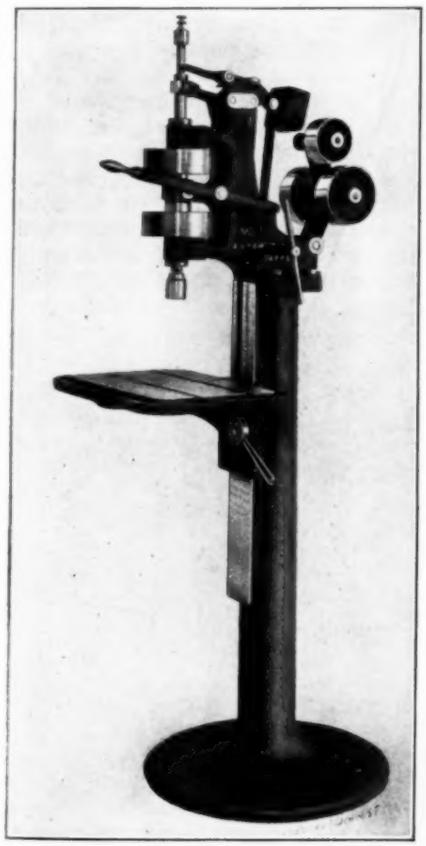
ANY new or improved machine or shop appliance of interest to our readers will be illustrated and described in this department.

A full and more detailed description will be given—when of special interest and it appears here before being sent elsewhere.

ALL descriptions appear in all four editions of the paper—Weekly, Monthly, Weekly English and Weekly German.

An Automatic Tapping Machine

The halftone shows an automatic tapping machine, with a counterbalanced table. The spindle is fitted with two friction pulleys, driven in opposite directions by one continuous belt, and between these pulleys plays a friction clutch keyed to the spindle. The friction clutch is connected with the lever at the right by a toggle arrangement which is adjustable for any desired tension, so that any extra safety device to prevent breaking of taps is unnecessary. The tap is started by the lever at the right, and is tripped and reversed automatically at any point by an adjustable screw stop on the upper end of the spindle striking the tripping lever on the top of the machine. The spindle is balanced and fitted with a sprocket over which a chain runs, which in turn is connected with the table at one end, and a counterbalance weight at the other end. The weight is inside the column. The machine will tap holes from ⅛ to ⅜ inch diameter in cast iron, to a depth of 1½ inches, and weighs 480 pounds. This machine operates satisfactorily at high speed, and after being set will trip and reverse even should the operator continue to press down the starting lever. The machine is manufactured by the Garvin Machine Company, Spring and Varick streets, New York.

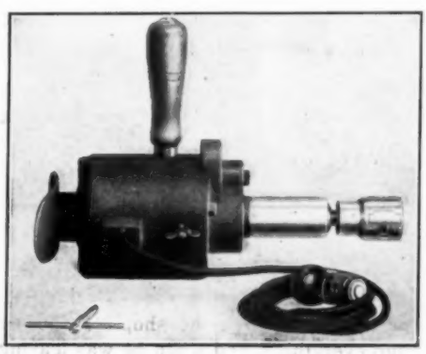


AN AUTOMATIC TAPPING MACHINE

positive-drive chuck for holding the taps. The table is surrounded by an oil groove, and is adjustable up and down on the column to suit the work by the cross handle shown in line with the lower spindle bearing. This handle is connected with a

A Portable Electric Breast Drill

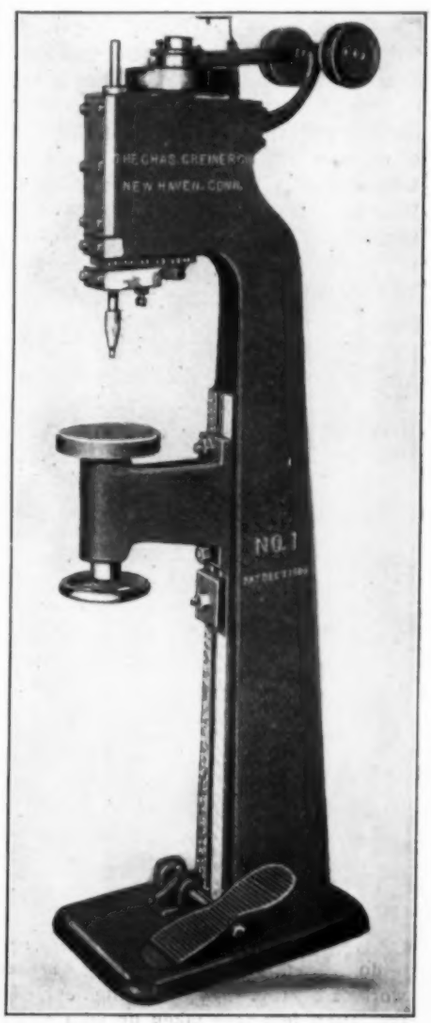
The halftone shows a new portable electric breast drill which has been brought out by the Willey Machine Company, Jeffersonville, Ind. The construction is very simple, but four gears are used and these are made from bar steel. The spindle has two long bearings with removable bushings of phosphor bronze. The electrical connections are attached to the main casing and need not be disturbed in case it is taken apart for any purpose. Air ducts in the shell provide for cooling. It is made in three sizes capable of drilling ⅜, ½ and ¾ inch respectively in steel. The motors are wound for either direct or alternating current and for any voltage up to 250. A snap switch on the side of the frame provides for starting and stopping. A special feature of these drills is their light weights, that of the 0 to ⅝-inch size being 12 pounds.



PORTABLE ELECTRICAL BREAST DRILL

A High Speed Riveting Machine

The halftone shows a rotary elastic blow riveter which has been put on the market by the Charles Greiner Company, New Haven, Conn.



A HIGH-SPEED RIVETING MACHINE

The operation of this riveter is by means of a cup and cone friction at the top of the machine, the fixed pulley having on its lower face a circular series of six camlike projections which, revolving in a horizontal plane, come in contact with a roller set in the top of an offset arm of the spring-actuated cylinder which contains a spring-cushioned hammer. The rotating motion of the hammer rod is derived from two sprockets, one being keyed on the lower end of the driving shaft and in chain-belt connection with the gun-metal sprocket on the hammer rod, which is recessed and bushed in the lower part of the head, the hammer rod reciprocating through it. The number of blows is variable by increasing or diminishing the number of projections on the friction pulley, but for ordinary purposes the machine has been found to operate to the best advantage when supplied with six projections striking about 6000 blows a minute.

The chuck is made to receive a straight-shank hammer, the hammer being secured therein by means of a set screw.

The machine has a foot treadle with which the machine is always under perfect control. The front of the machine is faced and grooved to receive a tongued table of either the horizontal or vertical type, and the tables are interchangeable, as in many cases it is found an advantage to have both tables to permit of handling the greatest variety of work. The machine is also furnished with a lower revolving fixture which strikes light reciprocating blows from below and is secured to the horizontal table when both threads of a rivet are to be formed simultaneously.

New High Speed Steel Furnace

C. U. Scott, of Davenport, Iowa, who has for some time been contributing articles to the AMERICAN MACHINIST on the heat treatment of steel, has recently started in the manufacture of heat-treatment furnaces. He will also act as consulting engineer on the heat treatment of steel and the necessary apparatus to be used for this purpose.

SCOTT'S HIGH-SPEED STEEL FURNACE

In Fig. 1 is shown his high-speed steel furnace. The furnace has no door or combustion chamber, and for this reason he claims it surpasses all others, owing to his being able to heat high-speed steel to the highest heat required without any scaling, pitting or blistering. It can be brought to a high heat in 30 minutes, and the heat is so perfect in its effect that polished steel can be heated, quenched and taken from the cooling bath a steel gray color, free from scale. Provisions are also made in the construction for heating only the cutting end of tools, and the most delicate tool can be hardened with safety.

Some of Mr. Scott's work in the designing and building of furnaces, and fitting up hardening rooms, is shown on page 694, Part 2, Volume 32, of the AMERICAN MACHINIST.

A Large Universal Milling Machine

The halftones show right- and left-hand views of the new Hendey No. 4 universal milling machine built by the Hendey Machine Company, Torrington, Conn. The gearing for speeds and feeds is practically the same as that used in the well known Hendey-Norton lathe built by the same concern.

The drive is by a single-step pulley with a clutch controlled by a lever. The gear cone on the spindle provides five changes of speeds which are increased in number to fifteen by the double back gears which are constantly in mesh with their relative gears on the spindle. The

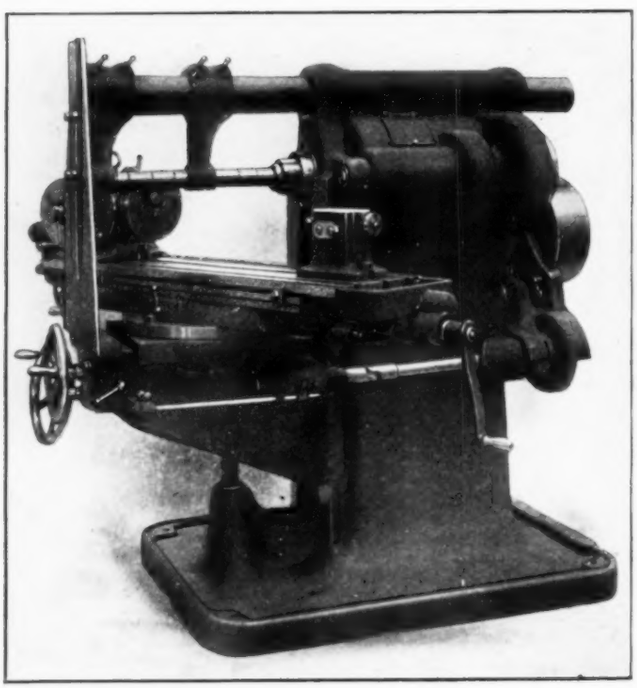


FIG. 1. A LARGE UNIVERSAL MILLING MACHINE

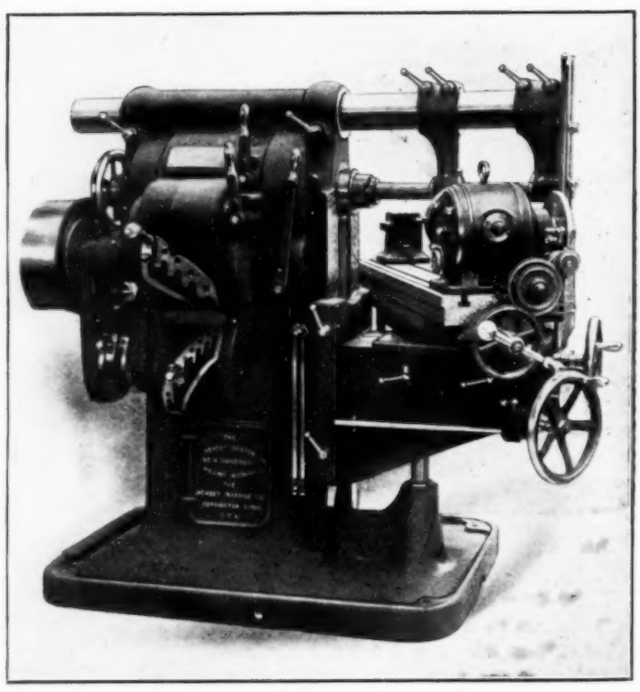


FIG. 2

back-gear clutch and the clutch on the spindle for stopping and starting are operated by two levers to the left of the front housing. The 21 feeds are all positive, through chains and sprockets, and have a range from ¼ inch to 25 inches travel of the table per minute. The feeds are all automatic and can be operated simultaneously and reversed while the machine is in motion. The quick-return-crank handle for the table has long leverage, free grip and disconnects when not in use. The working surface of the table is 55½x15 inches and has three ¾-inch T-slots. Longitudinal automatic traverse, 35 inches. Cross traverse, 12 inches. Vertical traverse, 20 inches. The index centers swing 15x31 inches. The dividing head has a front plate with three rows of holes; 24, 30 and 36. Only one side plate is furnished for worm-wheel indexing, it is divided on each side and has in all 18 rows of holes running from 15 to 49 holes per row. The vise opens 3⅝ inches and has jaws 6½ inches wide by 1 7/16 inches deep. The universal chuck is 9 inches diameter, and has three jaws. The arbor furnished is 1¼ inches diameter. Floor space required for this machine 108x117 inches; it weighs 6900 pounds.

A Duplex Hand Milling Machine

Fig. 1 shows a new hand-milling machine with vertical spindle in place. As will be seen, the vertical spindle is carried in the overhanging arm supports and is driven by belt from a pulley on the rear end of the horizontal spindle. When not required for vertical milling the attachment is easily replaced by the overhanging arm.

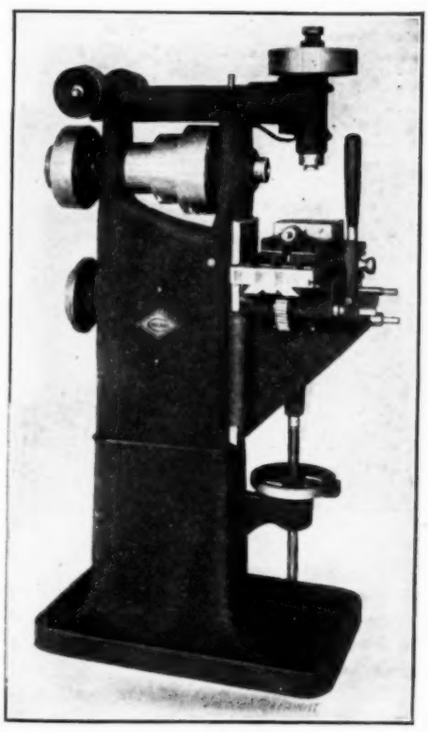
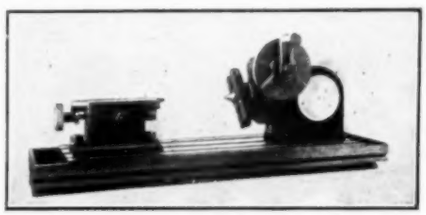


FIG. 1. A DUPLEX HAND-MILLING MACHINE



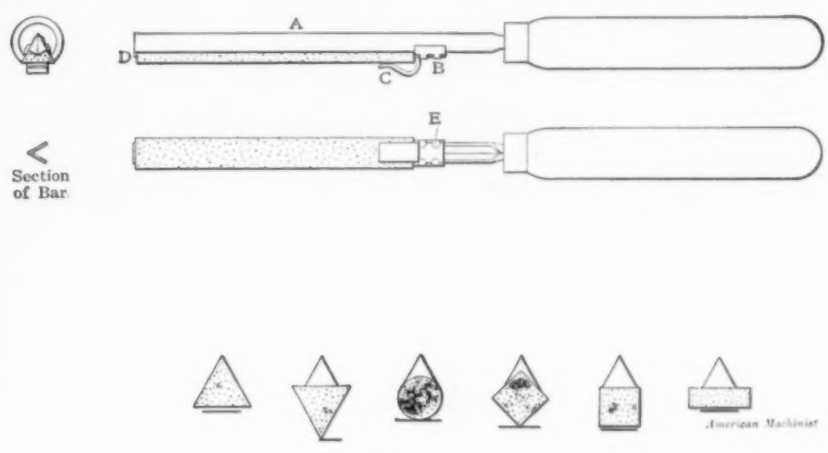
UNIVERSAL CENTERS

The machine has automatic feed to the table and quick return by hand lever. Fig. 2 shows the universal centers used on this machine. The worm being on the front end of the spindle instead of inside the head makes it possible to use one much larger than usual. These milling machines are built by the Chicago Machine Tool Company, Chicago, Ill.

Oilstone Holder

The tool illustrated holds oilstones of ¼ inch to ⅜ inch sizes, of triangular, square, round and rectangular cross section, and of any length up to 4 inches. The lapping of dies and punches and the stoning of the cutting edges of tools is much facilitated by its use, since the stones are conveniently and comfortably held. More pressure can be brought to bear on the stone which consequently cuts faster than if held in the fingers. Stones held in this device are not liable to breakage, and stones already broken too short to be held in the fingers can be effectively used. A ¼-inch triangular stone held in this device will easily enter a 9/32-inch square hole.

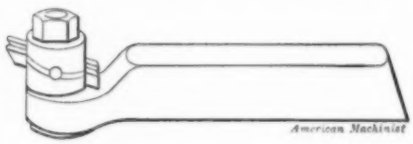
The bar *A* is pressed from sheet steel. *B* is a saddle fitting loosely over the *V* and capable of sliding the whole length of the bar. The spring *C* (of which there are four sizes to a set) slips under the tongues *E*, thus being instantly interchangeable. The pressure of the spring on the stone tends to cant the saddle and causes it to grip the *V* of the bar and lock itself in position. The abutment *D* prevents end motion of flat stones, which do not drop into the *V* of the bar. This device is manufactured by F. J. Badge, 286 Taaffe place, Brooklyn, N. Y.



OIL STONE HOLDER

Colton Holder for Two Tools

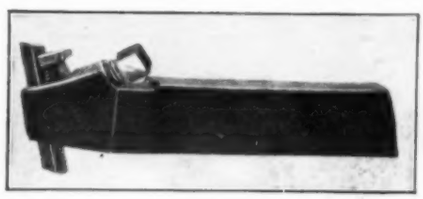
The illustration shows one of the Colton tool holders equipped with two cutters so as to divide the chip, which is often an advantage. The first, or leading cutter removes most of the stock, while the second cutter can be set to bring the work practically to size. The general construction is similar to the regular tool holder made by the Colton Combination Tool Company, Chester, Vt., but it is adapted in this case for the tool cutters shown.



COLTON HOLDER WITH TWO TOOLS

A Threading Tool

The halftone shows an improved threading tool which has been brought out by the Ready Tool Company, New



THREADING TOOL

Haven, Conn. The improvement consists in the method of holding the cutter. The dog engaging the teeth on the back of the cutter is provided with a head which, resting on the body of the holder, takes the downward thrust of the tool when under cutting pressure. The set screw need be tightened only enough to clamp the dog and tool in place and not enough to strain the holder in any way. In the halftone the dog is raised so as to show the shoulder which rests normally on the body of the tool.

A Gas Heated Soda Kettle

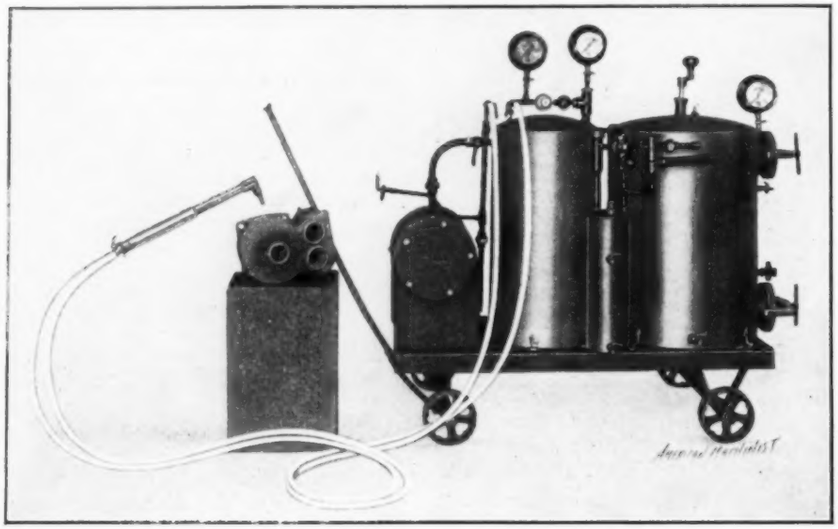
The Cleveland Machine Specialty Company, Cleveland, O., has recently placed on the market a soda and potash kettle, shown in the halftone, which is heated by gas. The burners are arranged in fixed position with relation to the kettle and either natural or artificial gas can be used.

A Gas-heated Soda Kettle

These kettles are made in two sizes of 10 and 30 gallons capacity. Dipping baskets of various sizes are furnished for washing machine parts.

A Portable Autogenous Welding Outfit

The halftone shows a portable welding outfit which has just been put on the market by the F. C. Sanford Manufacturing Company, Bridgeport, Conn. It was originally designed for garage work but has been found to be suitable for use wherever welding, which is not too large, is to be done.



Portable Autogenous Welding Outfit

The machine manufactures its own gases from chemicals which can be bought in the open market.

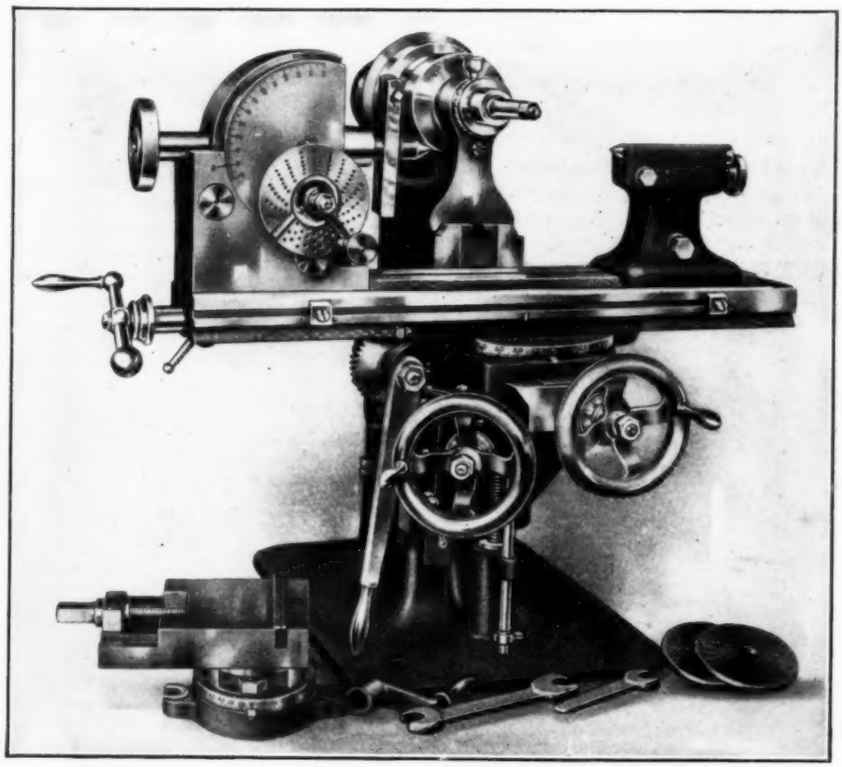
The outfit takes up a floor space 18 inches wide by 44 inches long, and stands 33 inches high. It weighs 415 pounds.

A Bench Milling Machine

The bench milling machine shown in the halftone is built for small, light milling on tool jig and model, as well as for regular manufacturing work, by B. C. Ames Company, Waltham, Mass. The head is the regular bench-lathe head built by the same concern. The table measures over all 21x4 inches and has a working surface 12x3 inches. It is provided with graduated base, rack and pinion feed and adjustable stops.

The knee at its lowest point brings the surface of the table 7½ inches from the center of the spindle. The transverse movement of the saddle is 3 inches. Stops and binder screws are provided on the vertical slides.

Dials on vertical, long and cross feeds read to thousandths. The centers swing 8⅜ inches and are made to the same standards and will interchange with the regular bench lathe made by the same concern. The head can be set at any angle from 10 degrees below horizontal to 5 degrees beyond perpendicular. It is graduated to degrees.

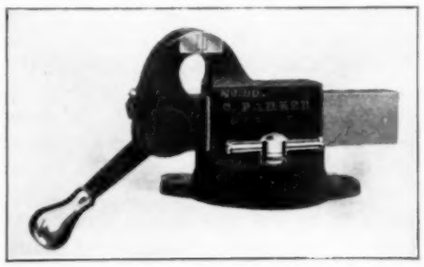


Bench Milling Machine

The countershaft is of the wall type operated from treadles under the bench. The vise has a graduated base, hardened jaws 3⅝ inches wide, ¾ inch deep and opens 1½ inches.

Quick Action Swivel Vise

The vise herewith illustrated is designed for quick action. In order to open the jaws the handle is lifted to a horizontal position, and when in this position the sliding jaw can be instantly regulated. As soon as the jaw touches the work the handle is depressed and the jaws secure a strong hold.

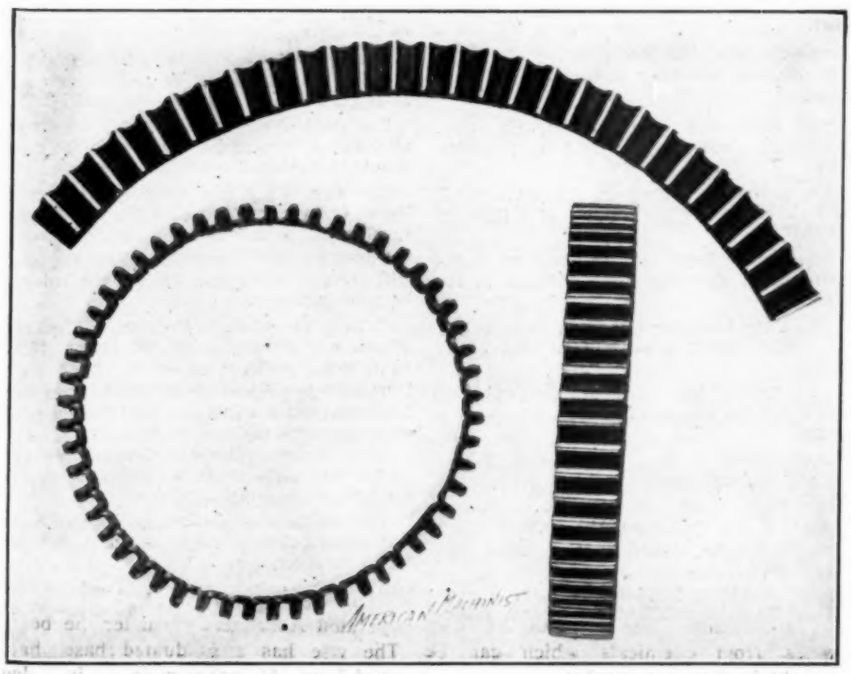


QUICK-ACTION SWIVEL VISE

This vise is made of a blending of steel and iron and is manufactured by the Charles Parker Company, Meriden, Conn.

Pressed Steel Gearing

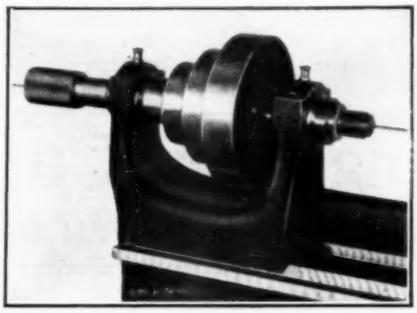
The halftone shows a new development in the shape of gearing which is being put on the market by the Johnston Pressed Gear Company, Ottumwa, Iowa. The teeth are formed up out of ribbons of steel, and are secured to suitable arms or spiders of pressed steel, by welding or brazing. Spur, internal, and bevel gears can be made by this method, which are light and fairly strong. In shape the teeth are hardly equal to those of well molded cast gears, but they are stronger than cast gears of equal weight.



PRESSED-STEEL GEAR TEETH

Spring Operated Spring Collets for Speed Lathes

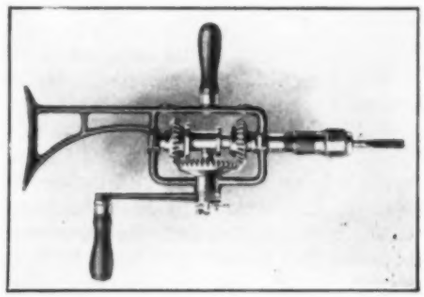
The Garvin Machine Company, New York, have brought out the equipment shown in the halftone which shows the headstock of one of their 10-inch hand lathes provided with a spring-operated draw-back collet. The spring is controlled by the turning of the nurled sleeve shown on the rear end of the spindle. Gripping the sleeve while the lathe is in motion releases the work. When the sleeve is let go the chuck is closed by the spring. The 10-inch lathe is fitted with No. 3 American Watch Tool Company's collets taking up to ¼ inch diameter. The 12-inch Garvin hand lathe is equipped with a similar device but operated by hand lever. No. 5 Rivett collets are used on the larger lathe with a capacity up to ¾ inch. With this device the lathe runs continuously, it being unnecessary to stop it to insert or remove the work.



SPRING-OPERATED SPRING COLLETS

A Combination Valve Grinder, Breast Drill and Ratchet

The halftone shows a combined valve grinder, breast drill and ratchet designed to meet the demand for such a tool for service on automobiles. The oscillating action for valve grinding is in an arc of a circle, not uniform, so many degrees to the right and so many degrees back, but steadily advancing to the right it does not travel twice consecutively over the same path.



COMBINATION VALVE GRINDER

The ratchet is both right or left hand as desired.

This tool is made by the Ashcroft Manufacturing Company, 85 to 89 Liberty street, New York City.

A Polishing and Grinding Machine

The halftone shows a new type of polishing machine which has recently been brought out by the Diamond Machine Company, Providence, R. I., to meet the demand for a machine which can be driven from a shaft below the floor. The spindle is 38 inches from the floor and wheels up to 16 inches diameter can be easily swung. The total floor space required is 33½x54 inches.

A POLISHING MACHINE

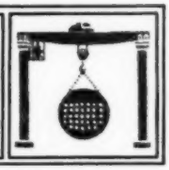
A Good Method of Softening Brass Plates

A metal pattern maker was given a job of adding ⅛ inch in thickness to some patterns which were made of very thin cast iron. He decided to rivet brass plates to such parts of the patterns as could be handled in that way, and after the plates were fitted, ready for riveting, it was found almost impossible to make the brass fit tight to the cast iron. Even though the rivets were spaced 1½ inches apart all over the surface, the brass plate would bulge up slightly between the rivet holes. The brass was of the "half hard" variety, being very kinky and inclined to spring. He decided to heat the brass sheets with the idea that after they were softened they would fit, or could be fitted closer to the cast iron. After heating and allowing the plates to cool, they were found to be in worse condition than before, but they could be hammered into contact with the cast iron provided a mallet was used for the driving. A mallet (wooden or fiber) may be used on brass, iron, or tin sheets to bend them without kinking or stretching any part; a hammer will surely stretch the metal, while a blow from a mallet simply bends it, but does not swage. The patternmaker did not succeed very well with the matter of making soft plates fit better than hard ones.

When the next job turned up, similar to the one mentioned, he heated the plates by first heating a piece of iron a little larger than the brass plate which had been milled smooth and true. He heated one of these plates as hot as the brass would stand—to a very dull red heat; then he laid the brass plate upon the hot iron one and put another and similar cast-iron plate on the outer side of the brass, making a quick hitch beneath an old pile-driver hammer, which had been suspended above a floor plate by means of a differential chain tackle. The weight was raised just enough to allow the plates to be slid underneath, then it was lowered on the run and the plates cooled soft and flat and remained in a very satisfactory condition.

Increasing Shop Capacities

Where More Tools will be needed



Authentic news is solicited for this department. Real opportunities for the sale of machinery of any kind.

The Sumner (Wash.) Shingle Mills will install new machinery.

The Solid Leather Shoe Company will build a factory at Preston, Ont.

R. E. & W. S. McDaniel will erect a planing mill at Creswell, Ore.

The Todd Lumber Company, Tacoma, Wash., will build a $15,000 plant.

James Brown will install a sawmill on his ranch at Husum, Wash.

The Sturgeon Shingle Mill, at Ballard, Wash., was destroyed by fire.

The Wolverine Brass Works, Grand Rapids, Mich., is to enlarge its plant.

The F. G. Deming Shingle Company, Markham, Wash., will erect a mill.

The Searcy (Ark.) Cotton Oil Company will install a 30-ton ice machine.

The handle factory of H. D. Hale, at Ashby, Ohio, was destroyed by fire.

The Grays Harbor Lumber Company of Hoquiam, Wash., will erect a mill.

Fire destroyed the garage of Brokaw Bros., Plainfield, N. J. Loss, about $75,000.

Frye & Co., of Seattle, Wash., will establish a packing plant in Portland, Ore.

The Southern Cotton Oil Company, Dublin, Ga., will erect a twelve-section ginnery.

The Buffalo (N. Y.) Auto Body and Trimming Company is to erect a new factory.

The Automatic Cattle Guard Company, of Sandpoint, Idaho, will erect a new factory.

The Canadian Northern Railroad shops will be located at New Westminster, B. C.

The E. H. Stanton Company, of Spokane, Wash., will erect a $500,000 packing plant.

The M. S. Steel Lock Company, of Clinton, Iowa, is to erect a two-stroy machine shop.

Fire damaged the Stuart Lumber Mills, at Vancouver, B. C., to the extent of $15,000.

The Valley Forge Cutlery Company, Newark, N. J., is to build a new one-story factory.

The M. S. Steel Lock Company, Clinton, Iowa, is erecting a two-story machine shop.

The Gilson Foundry Company, of West Bend, Wis., will locate in Kewaskum, Wis.

John D. McManus and Doss Swearingen, of Pendleton, Ore., are planning to erect a flour mill.

The Seattle (Wash.) Ice Cream Company will erect a condensed-milk plant at Montesana.

The Buffalo (N. Y.) Brewing Company will erect a one-story boiler and machine room.

The Clearwater Lumber Company, Orofino, Idaho, will erect a mill and power plant.

The citizens of Plainview, Neb., have voted to issue bonds for the erection of a lighting plant.

The Crystal Light and Ice Company, Paragould, Ark., is erecting an addition to its plant.

The Phipps Lumber Company, Fayetteville, Ark., will install a sawmill to cost about $3000.

The Golden Gate Mining Company, of Sitka, Alaska, will add five more stamps this summer.

John Blood & Bro., Philadelphia, Penn., hosiery manufacturers, will erect a two-story addition.

Platt & Co., Baltimore, Md., will erect an addition for the manufacture of oyster and lard cans.

Plans are being prepared for a new factory for the Rock River Machine Company, Janesville, Wis.

Bradner, Smith & Co., Chicago, Ill., are considering the erection of a paper mill at Rocton, Wis.

The Nute Foundry Company, Cuyahoga Falls, Ohio, will probably build another plant at Alliance.

The Capital mine at Osburn, Idaho, will install a compressor and make other improvements.

The John Schwing Corporation, Bridgeport, Conn., manufacturing cornices, etc., will erect a new shop.

The Cooper-Hewitt Electric Company, New York, has acquired a factory site in Hoboken, N. J.

Balfour, Guthrie Company will build a $250,000 wharf, elevator and flour mill at Portland, Ore.

The Hartford Carpet Corporation, Thompsonville, Conn., is building a large addition to its factory.

A new Corliss engine is to be installed in the municipal electric-light and water plant at Rogers, Ark.

The plant of the Hambleton (W. Va.) Tanning Company was destroyed by fire. Loss, about $1,000,000.

The Crescent Steam Laundry, Greenville, Penn., is contemplating changing from steam to electric power.

The Hampton (Iowa) Canning Company will shortly let contract for the construction of four buildings.

C. A. Reed and D. L. Prescott, of Spokane, Wash., will erect a $1,500,000 cement plant at Orofino, Idaho.

The Bridgeport (Conn.) Vehicle Company has taken out a building permit for an addition to its factory.

The Dawson Lumber Company, Libby, Mont., will make extensive improvements to its mill this spring.

The question of constructing water-works and electric-light plant at Walthill, Neb., is under consideration.

The Northwest Fisheries Company, of Juneau, Alaska, will start a cannery at Kenai, Cooks Inlet.

The Quaker Oats Company is to spend $40,000 on two new buildings at its plant in Cedar Rapids, Ia.

Plans are being prepared for a one-story machine shop for the Westinghouse Company, at Watessing, N. J.

The plant of the Lane Bridge Company, Painted Post, N. Y., was destroyed by fire. Loss, about $18,000.

The Texas Company, of Houston, Tex., is to erect an oil plant in Atlanta, Ga., at a cost of about $100,000.

J. S. King, of Dayton, Ohio, will establish a plant a Seattle, Wash., for the manufacture of oars and paddles.

Rockwood & Co., Park and Waverly avenues, Brooklyn, N. Y., will erect a new six-story factory to cost $150,000.

The Ansonia Clock Company, 1098 Twelfth street, Brooklyn, N. Y., will erect a six-story factory to cost $750,000.

The Robert Emmet Copper Company, of Corbin, Mont., has decided to build a concentrating plant this spring.

A slide at the Silver Cliff property, near Wallace, Idaho, carried away the blacksmith shop and compressor room.

An additional engine and two generators will be installed in the municipal light and water plant at Searcy, Ark.

The pumping and machine shop of the Rhode Island Coal Company, at Portsmouth, R. I., was destroyed by fire.

The Transcontinental Railway, Ottawa, Canada, has issued a list of tools required for shops at Winnipeg, Man.

R. W. Stevenson, of Seattle, Wash., is planning to erect a machine shop and forging plant at Cœur d'Alene, Idaho.

The Edward J. Knapp Candle Company, Syracuse, N. Y., has awarded contract for the erection of a new factory.

S. F. Bowser & Co., of Fort Wayne, Ind., manufacturing oil tanks, is to build an addition to its plant in Toronto.

The Myers Spalti Manufacturing Company, Houston, Tex., manufacturing mattresses, will build a four-story addition.

F. J. Miller, of Fostoria, Ohio, has been awarded contract to establish an electric-light plant at North Baltimore, Ohio.

The Northern Pacific Flour Mill Company will erect a large flour mill at Walla Walla, Wash. E. H. Leonard, manager.

The International Fibre Company, Seattle, Wash., will erect a plant. G. W. Thompson, 2316 East Ward street, president.

The Bessemer Railroad Company, Greenville, Penn., is enlarging its power house and will install 500-horsepower engine.

The Geo. E. Keith Shoe Company, of Brockton, Mass., is ready to receive bids for a new plant to be erected at North Adams.

Fire destroyed the plant of Russell Bros. machine shop and Poole Cash Register, at St. Catharines, Ont. Loss, $10,000.

It is reported that the Kilbourne & Bishop Company, of New Haven, Conn., will soon be in the market for some drop presses.

The Wheeling (W. Va.) Mold and Foundry Company has awarded contract for the erection of a new building to cost $20,000.

Fire did $50,000 damage at the chemical plant of Edward R. Squibbs & Sons, McKenna and Vine streets, Brooklyn, N. Y.

The plant of the Dowsley Spring and Axle Company, Chatham, Ont., Canada, is to be enlarged. About $15,000 will be spent.

Wm. H. King & Co., 122 Green street, Brooklyn, N. Y., manufacturing paints and varnishes, will erect a two-story addition.

W. Botsford, Portland, Ore., is seeking a site for the erection of a large lumber mill on the White Salmon river, near Husum, Wash.

The Winchester & Washington City Railway Company, Winchester, Va., has awarded contract for a steam power house to cost $40,000.

The Centreville (Ia.) Light and Traction Company will build a car house, repair shops, etc. Frank S. Payne, president and manager.

The Quaker City Chocolate and Confectionery Company, Philadelphia, Penn., will erect a new four-story factory to cost $60,000.

The Pierce Arrow Motor Car Company, Buffalo, N. Y., is enlarging its plant on Elmwood avenue. Machinery only partly decided on.

The Mohawk Herald Company, E. A. MacDermott, manager, will soon erect a new 10-stamp mill on the Anaconda mine, near Indio, Cal.

Belt & Walters, of Bloomington, Ill., will erect a plant in Shawnee, Okla., for the manufacture of culverts, siding, roofing, tanks, etc.

The Interstate Roofing Company, Anniston, Ala., will erect an addition to its foundry. Also contemplates the erection of a machine shop.

The Clinton (Ia.) Gas Light and Coke Company will erect a modern central electric power plant, to be equipped with turbine engines.

John Yown, C. E. Lurgens, of Libby, Mont., and others, are preparing for the installation of a cyanide plant about 35 miles from Libby.

T. G. Schweiger, Kansas City, Mo., took out a building permit for a two-story planing mill at 1525-31 Michigan avenue, to cost $20,000.

The Crescent Mining and Smelting Company, of Spokane, Wash., will erect a mill on the Shelby property in the Ten Mile district of Idaho.

Four buildings of the Union Handle Company's plant at Ashland, Ohio, were destroyed by fire, entailing a loss of $35,000. Will be rebuilt.

It is reported the Lake Shore Railroad is to begin the erection of a car-repairing plant at Ashtabula, Ohio, within 30 days, to cost $100,000.

The Manhattan Fireproofing Door Company, 412 East One Hundred Twenty-fifth street, New York, is to erect a $50,000 factory in Brooklyn.

The Hisey-Wolf Company, Cincinnati, O., manufacturing electrical drills and grinders, has purchased site on which a new plant will be erected.

The Perfection Mattress and Spring Company, Birmingham, Ala., will erect an addition for the manufacture of springs and spring beds.

Work was commenced on the factory for the Sanders Manufacturing Company, Rome, Ga., which will manufacture pea hullers and compost drills.

Twenty stamps will be added to the Fisher Creek Mining and Smelting Company's plant at Bramlett Creek, near Libby, Mont. Arthur Gooden, manager.

The Portland (Ore.) Manufacturing Company will establish a $75,000 varnish plant at St. Johns. Machinery worth about $50,000 will be installed.

Marion B. Davis, Relay, Md., doing screw-machine work, etc., is in the market for a second-hand screw machine to take one inch in good condition.

The Belgian Window Glass Company will erect a plant at Plesantville, Ohio. The company is capitalized at $25,000. T. J. Breadus is manager.

The Clinton (Iowa) Sugar Refining Company has taken bids for the erection of a five-story building, two-story building, one-story machine shop.

The Northwestern Wheel and Wagon Company will build a $50,000 factory at Portland, Ore. C. L. Tomlinson, Y. M. C. A. building, is president.

The Millerville (Ohio) Machine Company is erecting an addition to its plant to be equipped with new machinery for the manufacture of automobiles.

Fire damaged the plant of the Central Foundry Supply Company, Columbus, Ohio, to the extent of $3000, loss being mostly on machinery and supplies.

The Georgia Manufacturing Company, Rome, Ga., will build an addition and install new machinery for the manufacture of trucks and steel wheelbarrows.

J. F. Diefenbach, president of the Northland Milling Company, of Larimore, N. D., has made arrangements to build a 400-barrel flour mill at Great Falls, Mont.

The Garden City Fan Company would like to receive at its factory office at Niles, Mich., catalogs of manufacturers and dealers in machinery supplies and tools.

The Geometric Tool Company, New Haven, Conn., intends to put on an addition to its plant in which it is proposed to place grinding and polishing machinery.

The Seybold Machine Company, Dayton, Ohio, is preparing to build a large addition to its plant in Edgemont. The company manufactures bookbinding machinery.

The Rome (Ga.) Railway and Light Company will install a new 1000-horsepower turbine engine and make other additions and improvements to cost about $35,000.

The Anamosa-Oxford Junction Light and Power Company, Anamosa, Ia., proposes spending $50,000 in improvements, including a new engine, generators, water wheels, etc.

The Pullman Company of Chicago, will begin the construction of shops at Richmond, Cal., within a short time. These are to be along the lines of shops in Chicago.

The Louisville & Nashville Railroad Company contemplates the erection of a roundhouse, turntable, etc., at Paris, Ky. W. H. Courtenay, Louisville, chief engineer.

The Isthmian Canal Commission, Washington, D. C., will receive bids up to 10:30 a.m., May 2, for furnishing lumber, piles, steel castings, etc., as per Circular No. 571.

The Western Massachusetts Street Railway Company is planning to spend $50,000 on repairs and new work in Westfield, Mass., including an addition to its power plant.

The Vickers Auto Car Manufacturing Company, Coshocton, Ohio, which has produced its first automobile, will soon increase its facilities to give employment to 150 men.

The Philadelphia Watch Case Company, Riverside, N. J., propose building a concrete wet dock for landing coal from barges by means of an overhead monorail system.

The plant of the Shore Manufacturing Company, Rocky Mount, N. C., mattress manufacturer, was destroyed by fire, causing a loss of $12,000. Plant will be rebuilt.

An independent sheet and tinplate plant is to be erected by Pittsburg capitalists, at Glenova, W. Va. Senator Scott, of West Virginia, is at the head of the movement.

The Isthmian Canal Commission, Washington, D. C., will receive bids up to 10:30 a.m., May 3, for furnishing cast-iron car wheels and car journals as per Circular No. 572.

The Aldrich Manufacturing Company, 55 Illinois street, Buffalo, N. Y., has taken out a permit for a two-story factory. The company manufactures copper and brass goods.

The Covert Motor Vehicle Company, Lockport, N. Y., is building an addition to its plant, which will double the amount of floor space. Machinery only partly contracted for.

Alfred Terry, of Scranton, Penn., is investigating sites in Latonia, Ky., on which to build a $250,000 steel plant to be operated by Pennsylvania capitalists whom he represents.

The Brunette Saw Mill Company, of New Westminster, B. C., is making arrangements for increasing the capacity of its plant at Sapperton. New machinery is to be installed.

The Howard Motor Car Company, of Galion, Ohio, which was recently organized, will erect a plant on a site near Galion. Adam Howard, H. A. Pounder, W. J. Geer are among the directors.

The Georgia Southern & Florida Railway Company will make preliminary arrangements for the construction of repair shops at Valdosta, Ga. Wm. C. Shaw, Jr., Macon, Ga., chief engineer.

The steam plant of the Brooklyn (N. Y.) Rapid Transit Company, at foot of Court street, is being remodeled into a clothing factory. Will advertise for electric elevator to be installed May 1.

The Knickerbocker Typewriter Company has leased a factory at Niantic, Conn. Dr. W. S. Parker, of Trenton, N. J., has been elected president, and Chas. H. Cone, of Niantic, vice-president.

The Overland Motor Company, Indianapolis, Ind., has commenced rebuilding of plant. Will eventually be an entirely new plant. Tools have been purchased for lower floors, but not for upper floors.

J. T. Joyce, of Eau Claire, Wis., and D. Buchanan, of Chippewa Falls, Wis., are interested in a company formed for the purpose of developing power sites along the Chippewa and Flambeau rivers.

The Avery Company, Peoria, Ill., has taken out permit for the erection of a $100,000 addition to be used for the manufacture of its large traction engines and a new invention to be put on the market.

The Missouri, Kansas & Texas Railway, of Texas, will construct buildings at Denison, Tex., including car-repair shop, woodworking shop, power house, etc. A. M. Acheson, Dallas, Tex., acting chief engineer.

The Multi-Electric Company, incorporated, at Forth Worth, Tex., with $50,000 capital, will establish a plant for manufacturing electric motors. The Fostepco Heights Realty Company is to erect a new building.

Fire destroyed the four-story building containing milling department at the plant of the Iron Clad Manufacturing Company, Brooklyn, N. Y., makers of kitchen utensils and agateware. Loss, about $30,000.

The plants of the O. T. Zurn Oil Company, Harvey-White Company, manufacturer of sash, doors, etc., and Ternan & White, planing mill and lumber yard, Philadelphia, Penn., were practically destroyed by fire. Loss, about $600,000.

The Missouri, Kansas & Texas Railway, of Kansas, has awarded contract for the erection of additions to shops at Sedalia, Mo., including an addition to its car-repair shop, blacksmith shop, power house. S. B. Fisher, Dallas, Texas, chief engineer.

The General Electric Company has announced that $500,000 would be spent this year in addition to the Stanley plant at Pittsfield, Mass. These include annealing building, punch-press building, etc. Capacity of power plant will be doubled.

Bids will be received until 2 p.m., May 2, at the Treasury Department, Bureau of Engraving and Printing, Washington, D. C., for furnishing during the fiscal year beginning July 1, brass and iron castings. Blanks can be had of Joseph E. Ralph, Director of Bureau.

Sealed proposals will be received until 1 p.m., May 16, at Picatinny Arsenal, Dover, N. J., for furnishing during the fiscal year ending June 30, 1911, felt, rope, steel, iron, hardware, oils, chemicals, electrical goods, etc. For information apply to commanding officer.

The St. Johns River Terminal Company has awarded contract for the construction of buildings at Jacksonville, Fla., including roundhouse, turntable and foundation, water-softener plant, etc. Machinery proposals to be addressed to L. B. Rhodes, M. M., Georgia & Southern Railway, Macon, Ga.

Sealed proposals will be received at the Rock Island Arsenal, Rock Island, Ill., until 10 a.m., May 3, for furnishing hardware, leather, steel, iron,. oils, paints, chemicals, materials for heating and lighting etc., during the fiscal year ending June 30, 1911. Information furnished on application to Lieut.-Col. F. E. Hoobs.

The Han Yank Steel Company, of Kan Kow, China, has signed a contract with the Western Steel Corporation, of Seattle, Wash., to deliver 100,000 tons of pig iron and 100,000 tons of iron ore annually for a period of fifteen years. Plant for this purpose is now being erected at Irondale, Wash., and will commence operations about May 1.

The Natick Manual Training School, Natick, Mass., is in the market for a one-horsepower alternating-current electric motor, 60 cycle, 113 volts, 1 3/16-inch line shaft, with hangers, pulleys and belts, countershaft for 10-inch lathe, bench grinder complete, Nova Scotia grindstone with frame and countershaft, files, planes, sheet brass and other miscellaneous hardware, sloyd knives, hand vises, wax, sand paper, oils, etc. Address A. L. Graffam, director.

NEW INCORPORATIONS

Tulsa Automobile and Manufacturing Company, Tulsa, Okla. Capital, $75,000. Incorporators, D. R. Rody, J. J. De Shane, S. C. French.

James Kidney Motor Truck Company, Cincinnati, Ohio. Capital, $10,000. Incorporators, Jas. P. Kidney, W. W. Ramsey, W. A. Stuart, etc.

Athens Automobile Company, Athens, Ohio. Automobile repair shop. Capital, $10,000. Incorporators, A. F. Lawhead, R. C. Fulton, C. E. Mooney, etc.

Light Machine Company, New York. Manufacture and deal in engines, boilers, tools, etc. Capital, $50,000. Incorporators, S. Ergang, S. Polster, A. J. Rosemarin.

Safety Electric Company, Newark, N. J. Manufacture electric motors, dynamos, etc. Capital, $125,000. Incorporators, C. P. Taylor, C H. Fay, Scott German.

Selzer Heating Company, Akron, Ohio. Manufacture hot-water heating apparatus. Capital, $20,000. Incorporators, W. J. Selzer, H. D. Kiengle, K. H. Hays, etc.

Baltimore & Ohio Stone Company, Bascom, Ohio. Manufacture and sell crushed stone. Capital, $25,000. Incorporators, P. E. Lee, J. A. Ziegler, Lamar A. Lee, etc.

Nicholas & Bookwalter, Chicago, Ill. Engineering and machine-shop business. Capital, $20,000. Incorporators, George N. Morgan, Enos Bookwalter, Thos. E. Nicholas.

Minster Water Works Company, Minster, Ohio. Build water-works plant. Capital, $20,000. Incorporators, J. G. Westwater, Samuel S. Myer, Donald McKenzie, etc.

American Roller Screen and Stamping Company, Chicago, Ill. Window screens, sash, etc. Capital, $100,000. Incorporators, Henry Peterson, F. A. Swanson, O. D. Olson.

The Moore Silencer Company, New York. Manufacture and deal in firearms and supplies. Capital, $100,000. Incorporators, C. M. Dalby, H. Fletcher, W. J. Murphy.

Wm. A. Stokes & Co., New York. Manufacture and deal in woodenware, etc. Capital, $50,000. Incorporators, W. A. Stokes, E. B Cooke, New York; A. P. Lee, Brooklyn.

Tully Brown Company, Tully, N. Y. Manufacture brooms, brushes, etc. Capital, $20,000. Incorporators, Henry C. Crofoot, Tully; L. H. Langdon, 222 Kirk avenue, Syracuse, N. Y., etc.

Electrolitic Products Company, Buffalo, N. Y. Manufacture radiators and accessories for autmobiles, etc. Capital, $100,000. Incorporators, H. C. Steul, F. A. Abbott, J. Porzel.

Kurtzer Radiator Company, Cleveland, O. Manufacture automobile radiators and other accessories. Capital, $10,000. Incorporators, H. P. Kurtzer, F. M. Dunsford, G. M. Phillips, etc.

Culton Smoke Consuming Boiler Company, Johnson City, Tenn. Manufacture boilers, machinery, etc. Capital, $100,000. Incorporators, O. M. Culton, M. H. Weiler, H. H Dyer, etc.

Scherl Monorail Company, Jersey City, N. J. Manufacture monorail cars, automobiles, etc. Capital, $125,000. Incorporators, A. L. O'Shea, J. W. Hertzler, New York T. A. Renwick, Greenville.

The Winans Machine Company, Binghamton, N. Y. Manufacture and deal in machinery, tools, etc. Capital, $75,000. Incorporators, T. J. Winans, D. M. Winans, C. J. Knapp.

The Parcell Delivery Van Manufacturing Company, Toledo, Ohio. Manufacture delivery vans. Capital, $50,000. Incorporators, Wesley S. Thurston, Jr., E. Seney, F. M. Smith and others.

The Auburn Ignition Manufacturing Company, Auburn, N. Y. Manufacture and deal in automobile appliances, etc. Capital, $25,000. Incorporators, E. A. Raves, W. Franke, C. A. Franke.

Gyrox Manufacturing Company, New York. Manufacture and deal in engines, motors, automobiles, etc. Capital, $25,000. Incorporators, Ed. H. Stickels, Edgewater, N. J. H. L. Webb, Cresskill, N. J.

Delhi Water Works Company, Delhi, Ohio. Build water works. Capital, $20,000. Incorporators, J. G. Westwater, Samuel Myer, Donald McKenzie, etc. Mr. Westwater is president of the Mt. Vernon Bridge Company and resides in Columbus.

Bluebird Motor Cab Company, New Rochelle, N. Y. Manufacture, rent and deal in automobiles, motor cycles, etc. Capital, $40,000. Incorporators, J. K. Robinson, T. H. Bridgman, Pelham Manor, N. Y. E. W. Wilson, New York City.

Grafton Manufacturing Company, Martin's Ferry, Ohio. Smelting and refining ores and manufacture of metals. Capital, $50,000. Incorporators, W. S. Grafton, Frank Grafton and M. A. Grafton, of Wheeling, W. Va.; I. F. Bates and J. A. Monroe, Martin's Ferry.

BUSINESS ITEMS

Reeves Pulley Company, Columbus, Ind., has arranged with Le Sache, Virvaire & Co., Paris, France, for the building of the Reeves variable-speed transmission in France.

On April 1 the Van Dorn Electric and Manufacturing Company was consolidated with the Van Dorn & Dutton Company and will hereafter be known as the electrical department of the Van Dorn & Dutton Company.

The Chandler-Boyd Supply Company announces the commencement of its general

mill-supply business on April 15, 1910, at the Terminal warehouses, Pittsburg, Penn., with a complete stock of iron and brass pipe fittings and valves, wrought-iron pipe and steam specialties.

The bronze, brass and aluminum casting business of the Whitlock Coil Pipe Company, Hartford, Conn., has increased so that they have had to add to their already large capacity. They are now equipped to do the largest work as well as small castings and are doing a great deal of work for machines used for Government purposes.

The Standard Gauge Steel Company and the Standard Connecting Rod Company, of Beaver Falls, Penn., have consolidated and the business will hereafter be conducted under the name of the Standard Gauge Steel Company. A. Rasner, president of the new corporation, was formerly president of both corporations. J. T. Moltrup, formerly general manager of the Standard Connecting Rod Company, is the new vice-president and general manager. Stephen Moltrup, formerly manager of the Standard Gauge Steel Company, is treasurer and assistant manager, and John A. B. Patterson, formerly secretary of the Standard Gauge Steel Company, is secretary and assistant treasurer.

TRADE CATALOGS

Richard W. Jefferis Company, Camden, N. J. Folder illustrating and describing pressed-steel lockers.

American Locomotive Company, New York. Bulletin No. 1002, giving tractive power of simple locomotives. Eight pages, 8x11 inches.

The Industrial Instrument Company, Foxboro, Mass. Catalog No. 2, describing electric-time systems. Illustrated, 72 pages, 5½x9 inches.

The Merrell Manufacturing Company, Toledo, Ohio. Catalog of pipe-threading and cutting machinery. Illustrated, 6x9 inches, paper.

Scully Steel and Iron Company, Chicago, Ill. Blue Book for 1910, which is complete catalog of machinery and supplies. Illustrated, 304 pages, 4½x7 inches, leather.

Sawyer Tool Manufacturing Company, Fitchburg, Mass. Catalog of machinists' tools, including steel rules, gages, levels, calipers, etc. Illustrated, 58 pages, 4x5½ inches, paper.

FORTHCOMING MEETINGS

National Association of Manufacturers, annual meeting, Waldorf-Astoria hotel, May 16, 17 and 18, 1910. Geo. S. Boudinot, secretary, 170 Broadway, New York City.

National Metal Trades Association, annual convention. Hotel Astor, New York City, April 13-14, 1910. Robert Wuest, Commissioner, New England building, Cleveland, Ohio.

International Railway General Foremen's Association, annual convention, May 3-7, Grand hotel, Cincinnati, Ohio. L. H. Bryan, secretary, Two Harbors, Minn.

National Machine Tool Builders' Association, spring convention, May 24-25, Rochester, N. Y. P. E. Montanus, Springfield, Ohio, secretary.

American Society of Mechanical Engineers, spring meetings, Atlantic City, N. J., May 31-June 3. Calvin W. Rice, secretary, 29 West Thirty-ninth street, New York City.

American Foundrymen's Association and American Brass Founders Association; joint convention, June 7-8-9, Detroit, Mich.; headquarters, Hotel Pontchartrain. Richard Moldenke, secretary, Watchung, N. J.

National Gas and Gasolene Engine Trades Association. Semi-annual convention, Cincinnati, Ohio, June 13-16, 1910; headquarters, Hotel Sinton. Albert Stritmatter, secretary, Cincinnati, Ohio.

Master Car Builders Association; annual meeting June 15-17, Atlantic City, N. J. J. W. Taylor, secretary, Old Colony building, Chicago, Ill.

American Railway Master Mechanics Association, June 20-22, Atlantic City, N. J. J. W. Taylor, secretary, Old Colony building, Chicago, Ill.

Joint meeting of American Society of Mechanical Engineers and Institution of Mechanical Engineers, Birmingham, England, July 26-29, 1910.

American Society of Mechanical Engineers; monthly meeting second Tuesday. Calvin W. Rice, secretary, 29 West Thirty-ninth street, New York City.

Boston Branch National Metal Trades Association. Monthly meeting on first Wednesday of each month, Young's hotel. D. F. P. Clark, secretary, 309 Milk street, Boston, Mass.

Providence Association of Mechanical Engineers. Monthly meeting fourth Tuesday each month. E. C. Bliss, president, 91 Sabine street, Providence, R. I.

New England Foundrymen's Association; regular meeting second Wednesday of each month, Exchange Club, Boston, Mass. Fred F. Stockwell, 205 Broadway, Cambridgeport, Mass.

Engineers' Society of Western Pennsylvania; monthly meeting third Tuesday. Elmer K. Hiles, secretary, Fulton building, Pittsburg, Penn.

Superintendents' and Foremen's Club of Cleveland; monthly meeting third Saturday. Phil. Frankel, secretary, 310 New England building, Cleveland, O.

Western Society of Engineers, Chicago, Ill. Regular meeting first Wednesday evening of each month, excepting July and August. Secretary, J. H. Warder, 1735 Monadnock block, Chicago, Ill.

WANT ADVERTISEMENTS

Rate 25 cents per line for each insertion. About six words make a line. No advertisements abbreviated. Copy should be sent to reach us not later than Friday for ensuing week's issue. Answers addressed to our care will be forwarded. Applicants may specify names to which their replies are not to be forwarded, but replies will not be returned. If not forwarded, they will be destroyed without notice. No information given by us regarding any advertiser using box number. Original letters of recommendations or other papers of value should not be inclosed to unknown correspondents. Only bona-fide advertisements inserted under this heading. No advertising accepted from any agency, association or individual charging a fee for "registration," or a commission on wages of successful applicants for situations.

Miscellaneous Wants

Caliper catalog free. E.G. Smith, Columbia, Pa.

We buy or pay royalty for good patented machine or tool. Box 282, AMER. MACHINIST.

Machinery to order, or will purchase good patents. Interstate Machinery Co., Troy, N. Y.

Light, fine machinery to order; models and electrical work specialty. E. O. Chase, Newark, N. J.

Wanted—Second hand, one hand screw machine to take 1", good condition. Box 376, AMERICAN MACHINIST.

It pays to use multiple stops on your lathes; one firm bought eight. Address Box 391, AMERICAN MACHINIST.

High standard machine work, special machinery and duplicate parts built to order. L. & J. A. Steward, Rutland, Vt.

Special machinery accurately built. Screw machine or turret lathe work solicited. Robert J. Emory & Co., Newark, N. J.

Patented specialty wanted in line of heavy machinery. Schaeffer Machine Works, 35th & Gray's Ferry Road, Philadelphia, Pa.

Light and medium weight machinery and duplicate parts built to order; tools, jigs, etc. MacCordy Mfg. Co., Amsterdam, N. Y.

Oilstone holder, described on page 661, mailed for 25c.; shop agents wanted. F. J. Badge, 286 Taaffe Place, Brooklyn, N. Y.

Draftsman, expert on pneumatic tools and compressed air machinery, who can furnish complete workshop drawings. Box 363, AMERICAN MACHINIST.

A well equipped machine shop within 30 miles from New York solicits orders for all kinds of machine work. Send inquiries: The Brunswick Refrigerating Co., New Brunswick, N. J.

A large English firm of machine-tool importers having showrooms and offices in Great Britain, France, Italy and Japan, is wanting good agencies for machine tools of all kinds. Apply Box 189, AMERICAN MACHINIST.

An old established English firm with agents all over Europe, is prepared to represent a good American tool house, or will purchase, or distribute, really good patented articles in the hardware line. Fastnut, 60, Aldermanbury, London, England.

Dies and press tools for sheet-metal formation designed and constructed in a modern shop, under personal supervision of the best die man in this country. For dies, presses and anything in sheet-metal formation write to Joseph V. Woodworth, Mgr. Harwood Mfg. Co., 42 South 8th Street, Brooklyn, N. Y.

Firm of engineers, with good central office, shortly opening showroom in Glasgow and having first-class connection throughout Scotland in the engineering trade, desire good agencies for machine tools of all kinds. Reply, stating terms, etc., to Box A.A.6, AMERICAN MACHINIST, 6 Bouverie St., London, E. C.

Help Wanted

Classification indicates present address of advertiser, nothing else.

CANADA

Wanted—First-class toolmakers, particularly on punches and dies, steady work; wages from 35c. to 45c. an hour. Apply Canadian General Electric Co., Ltd., Petersboro, Ont.

CONNECTICUT

Wanted—Experienced mechanical draftsmen for detail work, in a concern manufacturing general rolling mill and hydraulic machinery; state age, experience and salary expected. Box 366, AMERICAN MACHINIST.

Wanted—An A-1 Acme automatic screw machine man; one who can supervise, lay out and design his own tools, etc., and one who can get maximum production on high "quality work;" every condition the best; this opening is made by plant doubling its screw machine equipment, all new machines. Box 362, AMERICAN MACHINIST.

Wanted—Mechanical draftsman with ability and experience to take charge of an uptodate drawing room for a concern building cold headers, thread rollers, screw slotters, wire formers, including full line of power presses; man must be energetic, accurate and able to furnish the best of references; steady work and good wages will be guaranteed the right man. Box 375, AMERICAN MACHINIST.

ILLINOIS

Wanted—Superintendent for gas engine factory; must be familiar with most modern machine tool practice and especially capable in cost reduction; must have executive ability and be systematic, energetic, and a first-class mechanic and competent to get maximum product and first-class work in all departments; able to handle successfully 500 to 1000 men; prefer man with technical education. Write fully, giving references, experience, age and salary expected. Box 384, AM. M.

INDIANA

Wanted—Machinists, we are continually increasing our force; we invite applications from lathe and floor hands, those who desire a steady position. Apply at Wood Turret Machine Co., Brazil, Ind.

MASSACHUSETTS

Toolmaker experienced in formed milling cutters; state age, experience and wages expected. Boston Gear Works, Boston, Mass.

Working foremen and machinists for day and night gangs; jobbing machine work and gear cutting; state age, wages expected and experience. Boston Gear Works, Boston, Mass.

Speed boss; man wanted to take charge of a New England machine shop employing about 25 men; must be familiar with modern methods of handling work, speeds, depth of cut and feed; state age, experience and pay expected. Address Box 9629, AMER. MACHINIST.

MICHIGAN

Wanted—Toolmakers, die sinkers, lathe hands, machinists and automatic screw machine operators; A-1 men only. Buick Motor Co., Flint, Mich.

Wanted—Machinists in Detroit; good machine and floor hands for medium and heavy work; good steady job with responsible concern to good men; state experience and references. Address Box 582, Detroit, Michigan.

NEW JERSEY

Wanted—Draftsmen familiar with heavy turret lathe work; give references and salary expected. Box 216, AMERICAN MACHINIST.

Wanted—First-class designer, draftsman and detailer on rotary printing machinery; A-1 man only; steady positions. Hall Printing Press Co., Dunellen, N. J.

Toolmakers wanted, conversant with subpress die work for small duplicate parts; factory located in Newark, N. J.; men who have worked on watch dies preferred. Box 385, AMERICAN MACHINIST.

Wanted—Machinists; steady work for good milling, boring, lathe and floor hands; also tool and die makers; call in person if possible; cheap rents and pleasant surroundings. Ferracute Machine Company, Bridgeton, N. J. (40 miles south of Philadelphia).

Wanted—Immediately, tool and diemaker for wide range of tool, die and mold work; if you are not a hustler and absolutely able to turn out good work quickly, don't waste time applying; permanent position in newly equipped and conveniently located shop to a man who makes good. Box 398, AM. MACH.

A mechanical draftsman wanted at once; one who is competent to make up estimates on compressed work; must be able to make up estimates of quantities and estimate labor for machine shop, plate and structural shop, and blacksmith shop; it is useless to apply unless applicant has had actual experience in estimating; give full details of experience and salary expected. Box 394, AMER. MACH.

NEW YORK

Draftsman familiar with work on bottle capping machines and Hopper feed for bottle caps wanted. Box 378, AMER. MACHINIST.

Mechanics and instrument makers, first-class only, wanted at once; state references and wages desired. V. W., 223, 1552 Broadway, New York.

Toolmakers wanted, experienced on fine jig and fixture work; give age, experience in detail and wages expected. Remington Arms Company, Ilion, N. Y.

Young man to sell mechanical tool; should be familiar with screw-machine practice; to receive attention state age, experience and salary expected. Box 388, AMER. MACH.

Wanted—Toolmakers on model and experimental special automatic machine work; good pay and steady work to competent men. Apply to S. S. White Dental Mfg. Co., Princes Bay, S. I., New York.

Wanted—A thoroughly uptodate foreman to take charge of a hustling automobile repair shop; none but a sober, competent man need apply; also two automobile machinists. Youngs & Co., Newburgh, N. Y.

A first class toolmaker, young man, married who is capable of developing into a working manager of a small manufacturing concern, can learn of a good opportunity by addressing "Opportunity," AMERICAN MACHINIST.

Wanted—Screw machine foreman, must be aggressive and used to quick set-ups; job consists of Brown & Sharpe and Gridley automatics and 15 to 18 hand machines; position steady, salary liberal. Box 342, AM. MACH.

Wanted—A chief draftsman by a large, well known automobile manufacturing concern in New York State; must be capable of handling large force of draftsmen; state age, education, experience and salary expected. Box 364, AMERICAN MACHINIST.

Wanted—Assistant foreman, thoroughly experienced in gears, to take charge of gear department, in large works in New York City suburb, cutting large bronze spiral and worm gears; applicants must state experience, age and salary expected. Box 368, AMER. MACH.

Wanted—Assistant foreman for a drilling department on a line of accurate, interchangeable work. When replying, state fully, past experience, names of firms by whom employed, in what capacity, age and wages wanted; no attention will be given to applications that do not contain this information. Box 382, AMERICAN MACHINIST.

Wanted—We are constantly increasing our force and invite applications from the following: Machinists, lathe hands, screw machine hands, grinder hands, milling machine hands, motor assemblers, toolmakers, sheet metal die men; we run a nine-hour shop, have desirable surroundings, and offer steady position to desirable characters. Address Superintendent, Maxwell-Briscoe Motor Co., Tarrytown, N. Y.

Wanted—Night foreman for milling machine department, doing high-class automobile work; we want a man who can produce accurate work, on a manufacturing basis; must understand piece work and rate setting; when applying, give age, experience, where employed for past six years, in what capacity, and salary expected; this information must be on application or applicant will not be considered. Box 383, AMERICAN MACHINIST.

Wanted—A thoroughly first-class and competent man between the ages of thirty and forty to take charge of a plant employing about one hundred men, manufacturing power transmission machinery; also special machinery, heavy work as well as light work, situated about fifteen miles from New York City; applicant must be a first-class mechanic, a systematizer, thoroughly conversant with modern methods; a steady position for a good man that can get maximum production out of all departments; applicants of highest standard of character and ability only considered. Write, giving full particulars and wages expected, "Progress," Box 386, AMER. MACH.

OHIO

Wanted—Draftsman, familiar with detail crane design; state wages desired. The Toledo-Massillon Bridge Co., Toledo, O.

Wanted—First-class lathe, boring mill, shaper and planer hands; inquire at once. The Heisler Company, St. Marys, Ohio.

Wanted—Floor, planer, lathe and milling machine hands; permanent position, good pay; no labor troubles. Box 337, AMER. MACH.

Wanted—First-class machinists, toolmakers, die sinkers, lathe, planer, drill press, screw machine, boring and milling machine operators, wood patternmakers, brass molders, polishers, buffers, finishers, spinners, millwrights, hammermen and blacksmiths who are seeking positions or desirous of improving on those which they have, to register their names and addresses with the free Employment Department of the National Metal Trades Association. Address Commissioner's Office, 605 New England Bldg., Cleveland, O.

PENNSYLVANIA

Wanted—Die setters, die makers, jig and fixture makers and wood pattern makers. Apply at Employment Department, Westinghouse Electric & Mfg. Co., East Pittsburg, Pa.

Wanted—Mechanical superintendent or general foreman, familiar with engine and boiler practice; state qualifications and expectations. Address General Manager, Box 361, AMERICAN MACHINIST.

Wanted—Draftsmen, detailers and tracers, by large steel company in the East; applicants must state age, experience, salary expected, and how soon they can report for work. Box 353, AMERICAN MACHINIST.

Wanted—Inside wiremen, tinsmiths, coppersmiths, sheet metal workers, Schwartz and crucible furnace hands and punch press hands. Apply at the Employment Department, Westinghouse Electric & Mfg. Co., East Pittsburg, Penn.

Wanted—A few draftsmen familiar with the design of jigs, fixtures, punches, dies and gages; also some detailers and tracers; tracers must submit samples of their work; only those who have had experience need apply. In answering state age, full experience and wages expected. Box 392, AMERICAN MACHINIST.

Wanted—Plain, slab and portable milling machine hands, horizontal and vertical boring mill hands, automatic screw machine hands, shaper hands, universal tool and shaft grinders. Apply at the Employment Department, Westinghouse Electric & Mfg. Co., East Pittsburg, Penn.

Foreman's assistant wanted in Philadelphia; must be experienced with tools for stamping, drawing and forming sheet steel; duties are setting dies in presses and handling a branch of press room; opportunity for a hustler, and one with ability for handling men to economically make articles from heavy sheet metal; one with bulldog stick-to-itiveness preferred; give age, experience and salary expected; answers kept in confidence. Box 358, AMERICAN MACHINIST.

Wanted—We have positions to offer from time to time for the following lists of first-class mechanics: Metal pattern makers; wood pattern makers; iron molders, bench; iron molders, floor; brass molders, bench; machinists; brass finishers, Fox monitor; brass finishers, turret lathe; toolmakers; work consists of brass and iron valves and fittings. In applying for any of the above positions state age, experience and wages. Address F. E. Johnson, Supt., The Kelly & Jones Co., Greensburg, Pa.

TENNESSEE

Wanted—First-class draftsman; one familiar with gas engine and gasolene motor car engine designs; only thoroughly experienced, practical man need apply; state wages desired. P. O. Box 358, Chattanooga, Tenn.

WISCONSIN

Toolmaker, first class, one with executive ability, with view of advancing to foremanship. Answer, stating age, nationality and full experience; good opening for right man. Box 381, AMERICAN MACHINIST.

Situations Wanted

Classification indicates present address of advertiser, nothing else.

CONNECTICUT

Mechanical engineer and draftsman, technical graduate, 5 years' experience in mill and power plant work, desires position. Box 365, AMERICAN MACHINIST.

Position wanted as master mechanic or chief engineer; experienced in the maintenance and repair of all mechanical and electrical apparatus and buildings in manufacturing plant; have had experience in electric power station, machine shop and manufacturing plant and designing and building special machinery. Box 389, AMERICAN MACHINIST.

ILLINOIS

A successful superintendent of the Otis Elevator Company is seeking change of position. Address Box 230, AMER. MACHINIST.

Position as superintendent; have a thorough knowledge of best machine shop and foundry practice; can get maximum production from men and equipment; accustomed to large works; good reasons for changing. Box 373, AMERICAN MACHINIST.

INDIANA

Foreman toolmaker, jig and fixture designer, experienced in outlining methods and operations in shop, wants to advance in position; go anywhere. Box 340, AMER. MACHINIST.

MASSACHUSETTS

Foreman or superintendent of machine shop; expert on quick, accurate work; good executive ability. Box 396, AMER. MACH.

Foreman, uptodate in modern shop methods, wide experience on price and rate setting, at present employed, desires change; age 39. Box 395, AMERICAN MACHINIST.

Advertiser, 42, would like position as New England representative; has practical mechanical experience as well as business training; has traveled abroad for leading American firms. Box 51, Fenway, P. O., Boston.

MICHIGAN

Wanted—Position as machine designer or shop superintendent; several years' successful experience in both positions; Middle West or South. "S. H. J.," Box 379, AMER. MACH.

NEW JERSEY

A young man graduating from a technical college in May, wishes a position. Box 387, AMERICAN MACHINIST.

Foreman of manufacturing department of large modern factory wishes change, either as general foreman, tool room foreman or superintendent; extended experience on all automatic screw machines, also on designing of special machinery tools and dies; technical, practical and executive; married; 10 years' experience; age 29. Box 393, AMER. MACH.

NEW YORK

As superintendent or general foreman, by expert in light manufacturing, tool and special machine designing. Box 372, AM. MACH.

I wish to correspond with reliable firm desiring the services of an uptodate foreman for tool department; can organize to advantage. Box 390, AMERICAN MACHINIST.

Young man, experienced sales representative steel and machinery line, executive ability, desires to represent out of town concern in New York and vicinity for sales of their product on salary basis. Box 399, AM. MA.

Designer, able to show letters and recommendations proving 8 years' experience in machine and tool design, wants position in East as chief draftsman or designer at no less than $40 per week. Address Box 377, AMER. MACH.

Position as superintendent; now employed in similar position handling 250 hands; A-1 mechanic; wide experience in manufacturing small or medium interchangeable parts; first-class organizer and executive; can produce results. Box 397, AMERICAN MACHINIST.

OREGON

Master mechanic with 20 years' experience, United States, Canada and South America; practical man; strong as constructing engineer and organizer of complete plans; services with such concerns as Merganthaler Linotype Co., Campbell Printing Press Co., United States Metals Refining Co.; 40 years old, single; speaks English, German and some Spanish; wishes engagement where a high-grade service is required. Address Box 514, St. Johns, Oregon.

PENNSYLVANIA

Mechanical draftsman desires change; go anywhere; seven years' experience; Pennsylvania preferred. Box 380, AMER. MACHINIST.

FOR SALE

For Sale—200-horsepower Harris-Corliss engine in perfect condition; the reason for selling mill business discontinued. The Elm City Lumber Co., New Haven, Conn.

For Sale—One Nash gas engine, 20 horsepower, two cylinder, for electric lighting, pumping or power; one Beaman & Smith horizontal boring mill; table 25 inches wide, 36 inches long; will bore 12 inches diameter, 24 inches long, and face 20 inches diameter; one 300 light J. B. Colt Co. acetylene gas apparatus. The above machines are in excellent condition, having been very little used. For further particulars and prices apply to Rider-Ericsson Engine Co., 35 Warren St., New York.

Davenport Multi-spindle Automatic Screw Machine

Plan and Construction Embody Important, Interesting Features

Editorial Correspondence

A multiple-spindle automatic screw machine embodying numerous features of novelty and interest is illustrated by the accompanying halftone and line engravings. This machine takes stock up to ½-inch round rods, feeds up to 2½ inches and turns 2 inches in length. It is built by the Davenport Machine Tool Company, New Bedford, Mass.

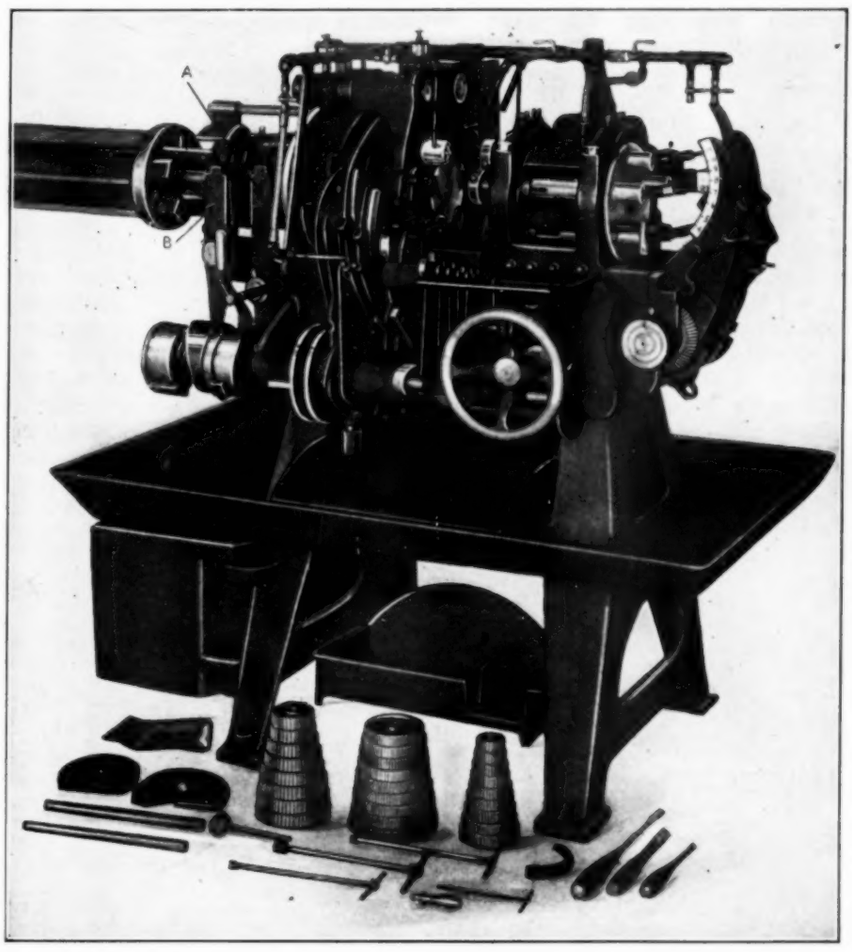


FIG. 1. THE DAVENPORT MULTIPLE SPINDLE AUTOMATIC SCREW MACHINE

GENERAL FEATURES

The machine has five spindles, providing sufficient tools for finishing the best classes of work and is operated by a single belt drive. It is arranged for quick indexing of the spindle head, making the idle or non-cutting movements short, with the maximum time for the tools to do their work, and there is a wide range of spindle speeds adapted to all kinds and sizes of work within its capacity, at efficient cutting speeds. There is a separate feed for each tool, adjustable for the length the tool must travel for finishing the work, assuring accurately finished work and durable tools, and a wide range of feeds is provided by means of change gears suited to all kinds of material and sizes of work, with best possible feed for speed and smoothness of work. The spindles always revolve forward, facilitating the setting and grinding of tools. Compensating stops are provided for the forming tools, insuring work of uniform size from all of the spindles.

THE WORK SPINDLES AND THE DRIVING MECHANISM

The general appearance of the machine is well illustrated by Fig. 1. The arrangement of the spindles and the method of driving will be understood from the sectional drawings Figs. 2 and 3.

The five work spindles are hardened, ground and lapped and run in phosphor-bronze boxes. The front box is adjustable to compensate for wear and the rear box is adjustable for end thrust. As will be seen upon examination of Fig. 2 the spring chucks do not move endwise when opened and closed, but, instead, they are operated in fixed position laterally, by the closing tube which is pushed forward to grip the chuck upon the work.

As indicated in Fig. 3, the drive is by one belt from the countershaft, to a pulley on the back side of the machine where it will not interfere in making adjustments. Change gears from this shaft drive another shaft with gears meshing into the spindle driving gear. The spindles are driven as shown in Fig. 2 by an internal gear running on the hubs of the spindle gears, on their pitch diameter, making a free running rolling bearing. The change gears provide for 8 spindle speeds ranging from 395 to 1310 turns per minute, suited to all kinds and sizes of work within the capacity of the machine.

STOCK FEED TUBES

The stock feeding tubes have an extra bearing at the left of the regular spindle bearings, insuring their running true and adding to the life of the spindle bearings. This outside bearing is a hardened and ground shell on the feed tube, and runs in phosphor-bronze boxes.

When desired, special feed tubes with the feed fingers soldered instead of screwed in place can be furnished for ½-inch hexagon, 7/16 square and 9/16 round stock. The bars of stock run in wood tubes to avoid excessive noise, and prevent marking of the stock.

Referring again to Fig. 1, the lever for operating the chuck will be seen at *A*, the stock feed at *B*. These levers are actuated by cams on the shaft below and at the front of the machine. The stock is fed against a stop which is made a part of the first turning or other turret tool. The length the cams feed the stock is controlled by a nut on the left-hand end of the shaft, and the stock stop is adjusted by a nut near the lower front sliding spindle.

INDEXING THE WORK SPINDLE HEAD

This head is indexed in one second, during which time the chucks are opened, the stock fed forward to the stock stop, the chuck closed again and the feed tube drawn back ready for the next feeding of the stock. This movement is smooth and

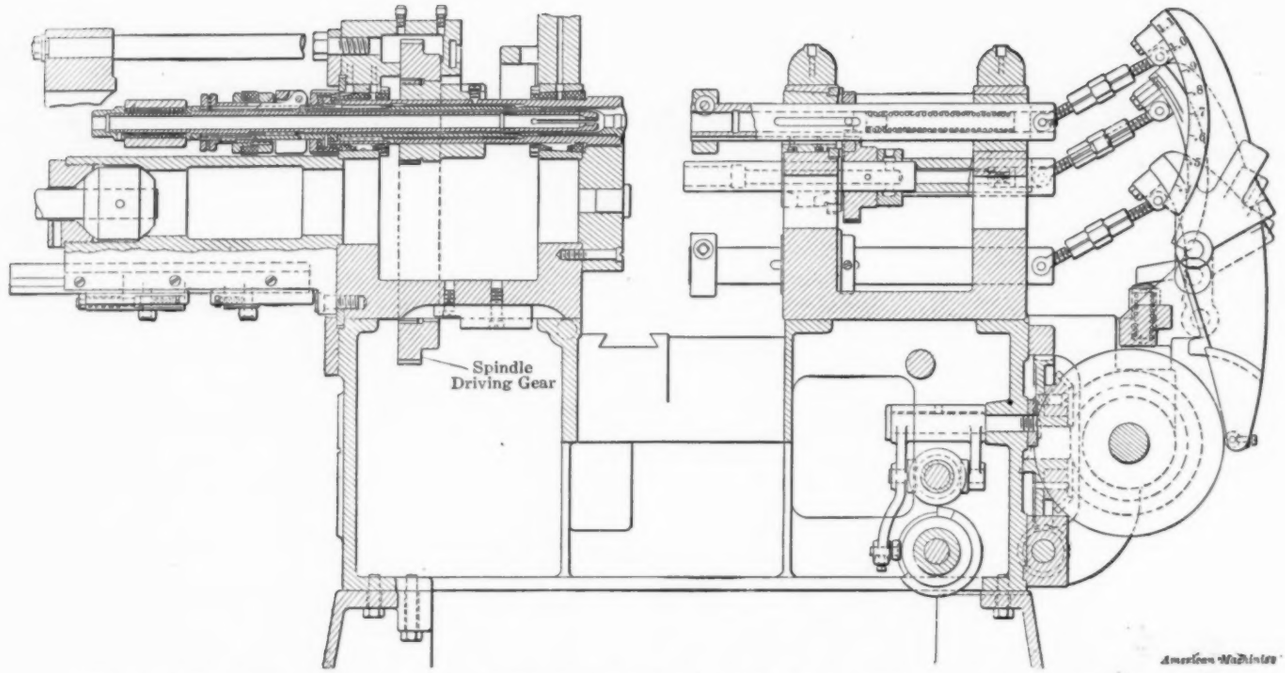


FIG. 2. LONGITUDINAL SECTION SHOWING ARRANGEMENT OF SPINDLES IN DAVENPORT AUTOMATIC SCREW MACHINE

rapid. The shaft in front of the machine and near the bottom of the bed makes one quick turn to accomplish these movements and then stops.

The parts which lock the head are mounted on a lever shown in Fig. 3. This lever has a notched shoe *C* engaging with each of the five locking blocks *D* as these are indexed in succession into position under the upper end of the lever. The indexing movement is accomplished by the two pawls carried by rod *E* which is itself operated at the right moment by crank disks *F*. This crank motion gives an easy start to the indexing mechanism and brings the spindle head to rest easily ready for locking. The two pawls engaging opposite sides of the indexing blocks insure the head traveling the exact distance desired in the indexing movement.

The locating side of the locking parts is radial with the center of the revolving head, and is not subject to wear. This locking lever is not only pulled out of engagement positively, but is also positively pushed back into the locking position by means of the double cam and forked end of the lever shown in Fig. 3.

In addition to this locking of the head, it is also clamped by the front cap being tightly drawn down on it, thus securely holding it in place under heavy cuts. The cap-clamping device is brought out clearly in Fig. 3.

THE TOOL SPINDLES

Provision is made for five "turret" tools, as they are usually called, and four cross-slide tools, each one on its own slide, and each with independent movement.

The "turret" tools are mounted in sliding spindles, each of which is operated by a separate cam, as shown in Figs. 2, 4 and 5. These cams move the levers at the right-hand end of the machine, and the connecting rod from each spindle to its lever is attached to an adjustable block on the lever, by which the tool is made to advance the same amount as the throw of the cam, or a less amount, down to one-half the throw of the cam, by adjusting the block on the lever to the corresponding position. The face of the lever is graduated to indicate the movement of the tool relative to the throw of the cam.

The connection between the tool

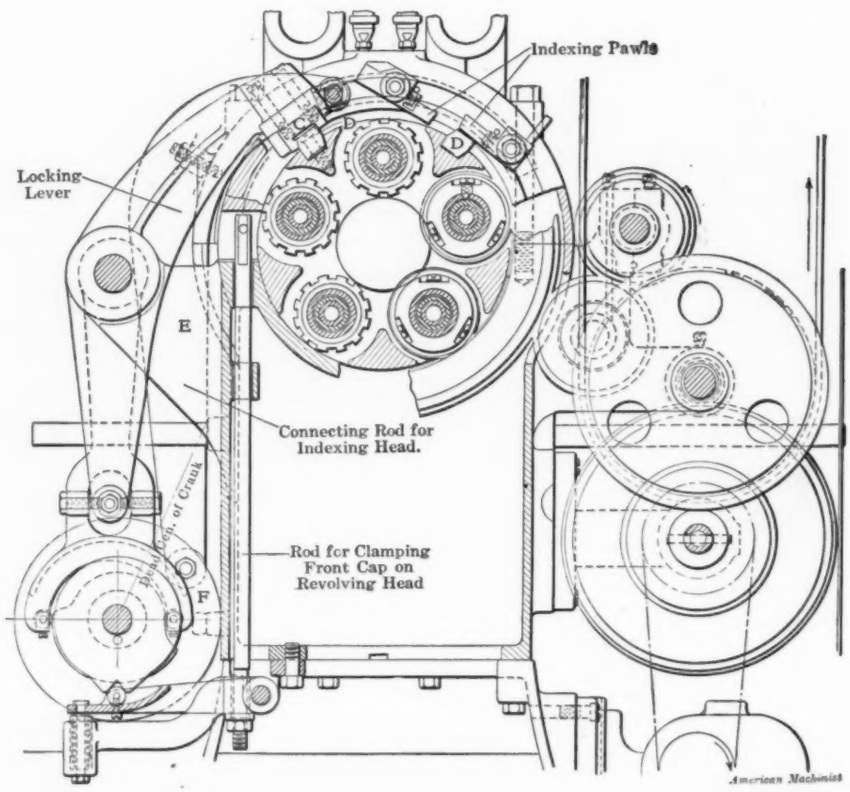


FIG. 3. WORK SPINDLE DRIVE AND INDEXING MECHANISM

spindle and the block on the lever has a turnbuckle connection, by which the tools can be adjusted lengthways of the work, quickly and accurately. The adjustment of the block on the face of the cam lever permits the feed of dies and taps to be regulated very accurately to suit the pitch of the thread. With the connecting rod adjusted to the top of the cam lever a lead can be obtained practically double that with the rod set at the lowest point of adjustment on the cam lever.

Cams and Cam Shafts

As already stated, each tool has its own cam, and these with the adjustments described cover a wide range of work. For example, the cam for turning 2 inches, which has a rise or throw of 2 inches, is made equally efficient for turning one inch, by setting the block on 0.5 on the lever. There are 15 cams furnished with the machine, and these cover the usual lines of work made on the machine. For large quantities of certain kinds of work, it is well to use special cams. They are made from cold-rolled steel, 5/16 inch thick and casehardened. The edge of the cam is accurately milled to an even rise.

The cam shafts for feeding the tools are stopped when the spindle head is being indexed. This is to insure the best conditions for both slow and rapid work as the tools are quickly brought into position after the head is indexed by the cam shaft starting again.

tion clutch (shown at the right and below the driving pulley in Fig. 6) operated by the hand lever at the left and front of the machine. This friction clutch is held in engagement by a spring, to allow it to slip in case of accident.

Change gears are provided giving a range of from 3 to 51 seconds per piece made, varying by one-half second up to 7 seconds, then by one second to 21 seconds, and then by two seconds. These change gears are shown at the lower left-hand corner of Fig. 6. The drive is readily traced out here, from the friction clutch, through the long feed-driving shaft with its bevel gears to the change-gear train which in turn operates the cross-worm shaft, Fig. 5. This shaft has right- and left-hand worms for driving the front and rear cross-slide cam shafts, and bevel gears at the sides of the worm wheels coöperate in driving the tool-spindle cam shaft without back lash.

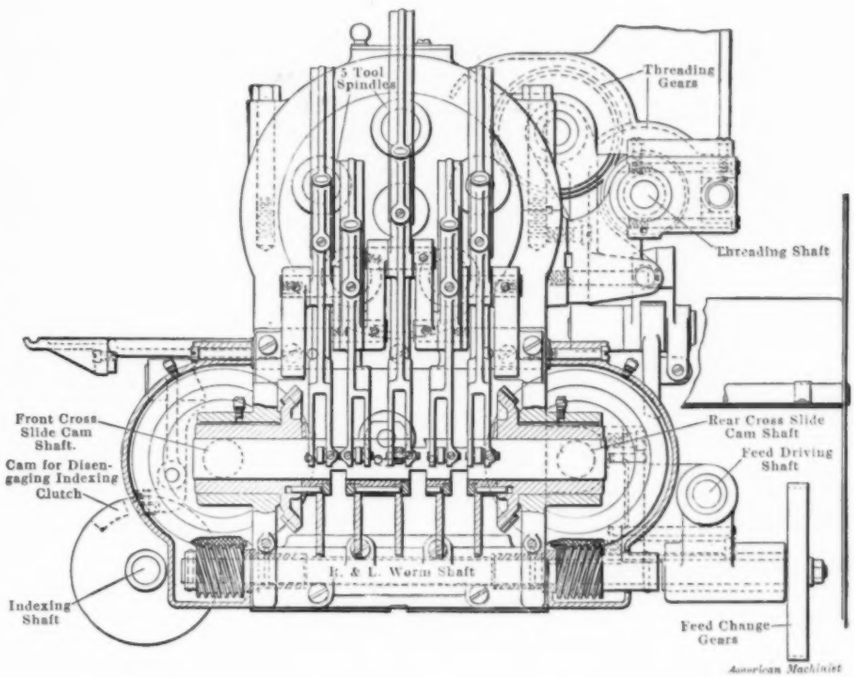


Fig. 5. End View of Tool-spindle Levers and Cam-shaft Drive

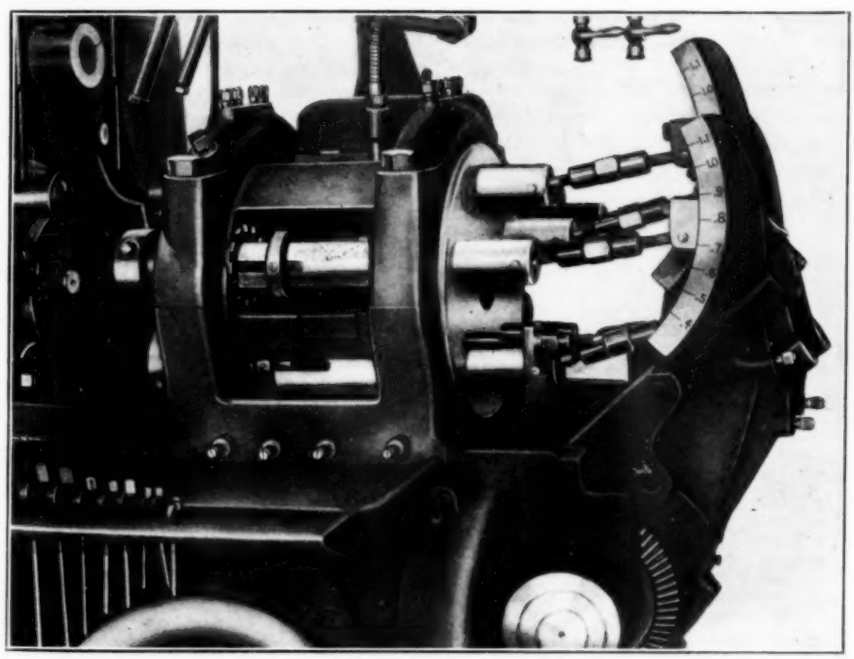


Fig. 4. Independent Cam Levers for Operating Tool Spindles

Cam Shaft or Feed Drive

The drive for the cam shafts is illustrated by Figs. 5, 6 and 7. This feed drive is by the same belt as the spindle drive and from the shaft through a fric-

Indexing Shaft Drive

Referring to Fig. 7, it will be noticed that the feed-driving shaft also operates the handwheel shaft which is driven continuously when the feed driving clutch is engaged. The indexing clutch near the front end of this shaft is disengaged except when the work-spindle head is to be indexed. When the member marked "cam for starting index" comes into contact, upon each revolution of its shaft, with this clutch and throws it into engagement, the indexing clutch shaft below is driven through one revolution, causing the lower front shaft of the machine to revolve once and index the work-spindle head. At the same time, the clutch-indexing shaft in rotating releases the feed clutch on the handwheel shaft and the feed cams then remain at rest during the indexing and stock-feeding movements of the work-spindle head.

Cutting Off and Forming Tools

There are two regular cross slides, and two swinging arms for similar work. Each has the same adjustable movement as the turret tools. These provide for

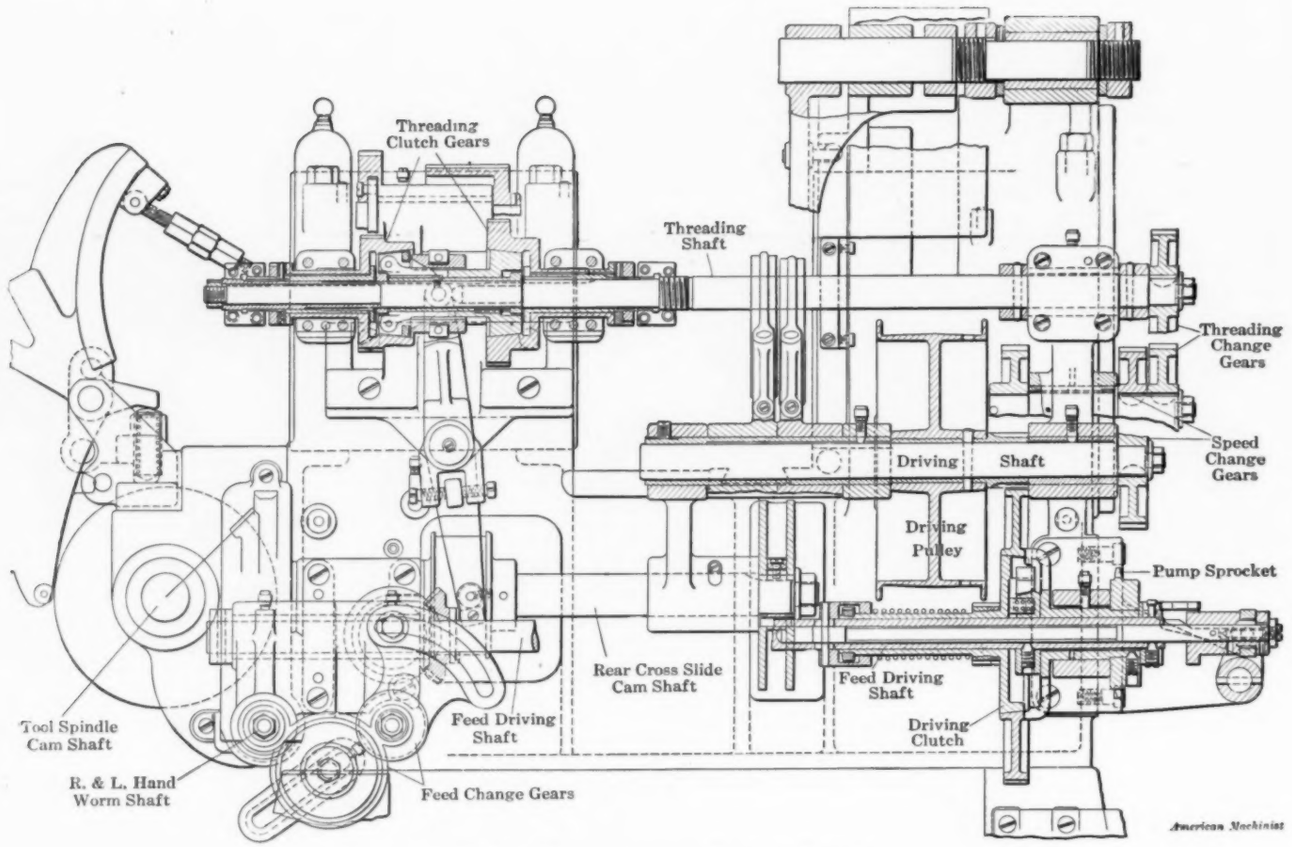


FIG. 6. REAR ELEVATION AND PARTIAL SECTION

one cutting-off tool and three forming tools where they are required, or several can be used for cutting off, according to the work being made.

Circular forming and cutting-off tools are usually used, and they have straight holes so that they can be centered accurately. The tools have a pin in one side, which fits into holes in a worm wheel in the tool post. This makes an accurate and quick means of adjustment for the hight of the cutting edge when setting after sharpening, or in setting up a new piece. There is also a clamp at the side of each tool for holding it rigidly. Each tool also has a screw for longitudinal adjustment, and an eccentric for making a forming tool cut parallel or otherwise as desired, with the center of the work.

CROSS SLIDE STOPS

Each tool post has a stop screw for regulating the size of work formed, the same as on a single-spindle machine, and in addition, an adjusting screw, or compensating stop in the spindle-revolving head, for each spindle, to insure the same size of work being formed in each of the five spindles, even after the boxes or spindles have become worn. These stops for one of the spindles will be seen at *G*, Fig. 8, and the general arrangement will be understood upon examination of Fig. 9.

This drawing shows the two cross slides, the two swinging slides, the four cam levers which operate them, and the compensating stops for each work spindle by means of which the tools are forced to cut to uniform size for all of the spindles. Thus, at *H I* will be seen the stops for the front cross-slide tool and swinging tool for one spindle, and alongside of these stops will be noticed two more which accurately stop the rear cross-slide tools when the spindle has been indexed around to its rear position. This means that for each spindle there are four separate stops which, when once adjusted, bring all work handled in the five spindles to uniform diameter. In setting up for any given diameter of cut, the cross-slide tools themselves are adjusted by the square-head screws illustrated under the tool blocks.

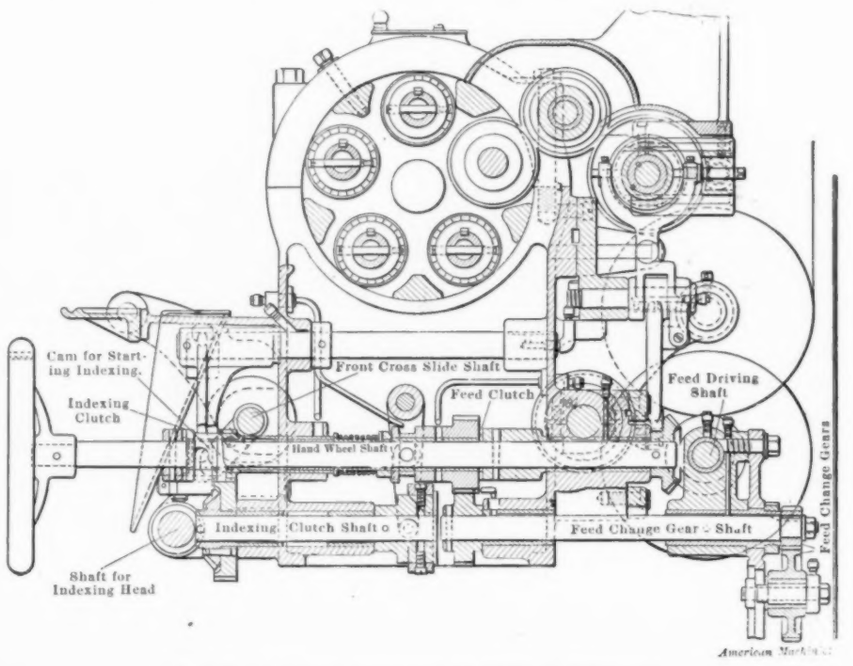


FIG. 7. SECTION THROUGH CLUTCH MECHANISM

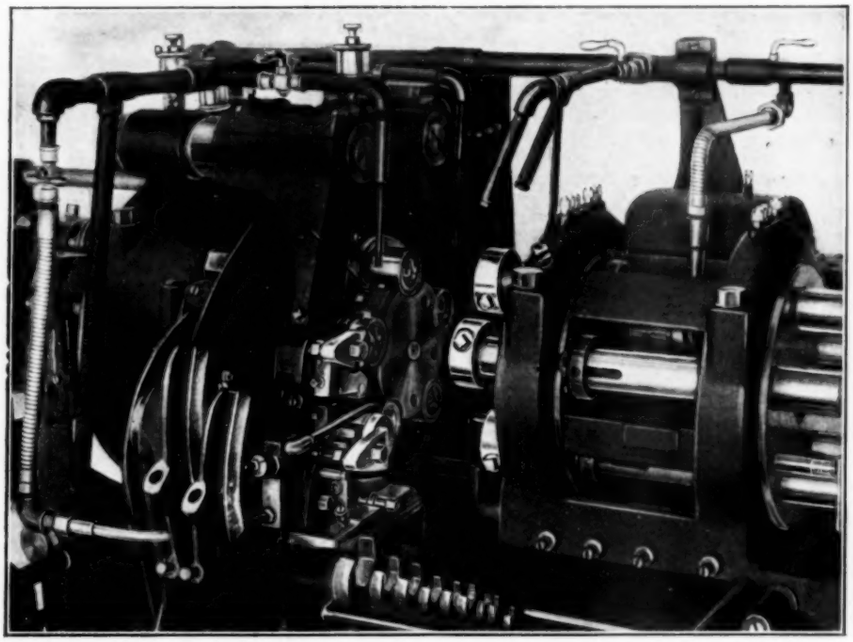


FIG. 8. CROSS-SLIDE TOOLS AND STOPS

CUTTING THREADS

As already noted, the work spindles revolve forward and are not stopped or reversed for threading operation. The tool spindle carrying the die or tap, is revolved in the same direction as the work spindle, but at a lower speed when running the die on, and at a faster speed to run it off. The ratio when running on is about 3 to 4, so the threading speed is one-fourth of the spindle speed when on the same size work, and as the threading size is usually much smaller than the outside of the stock, the threading speed in feet per minute is very low, allowing the dies to stand up and assuring smooth threads. The running off of the die is accomplished rapidly. The speed ratio of turning to threading is 6 to 1 for right-hand threads and 8 to 1 for left-hand threads.

The threading-spindle mechanism is shown in Fig. 6. The long shaft near the top of the machine, known as the threading shaft, is driven from the single pulley shaft through change gears at the right-hand end of the machine. This long shaft has a male part of two friction clutches engaging either of two friction-clutch gears of different diameters which in turn drive the gears for running the threading spindle at different speeds for threading on and off. These gears are controlled by this friction clutch body which is actuated at the required moment in the cycle of operations, by the sleeve shown between the gears which is slid to and fro by cam and quick-acting lever as indicated.

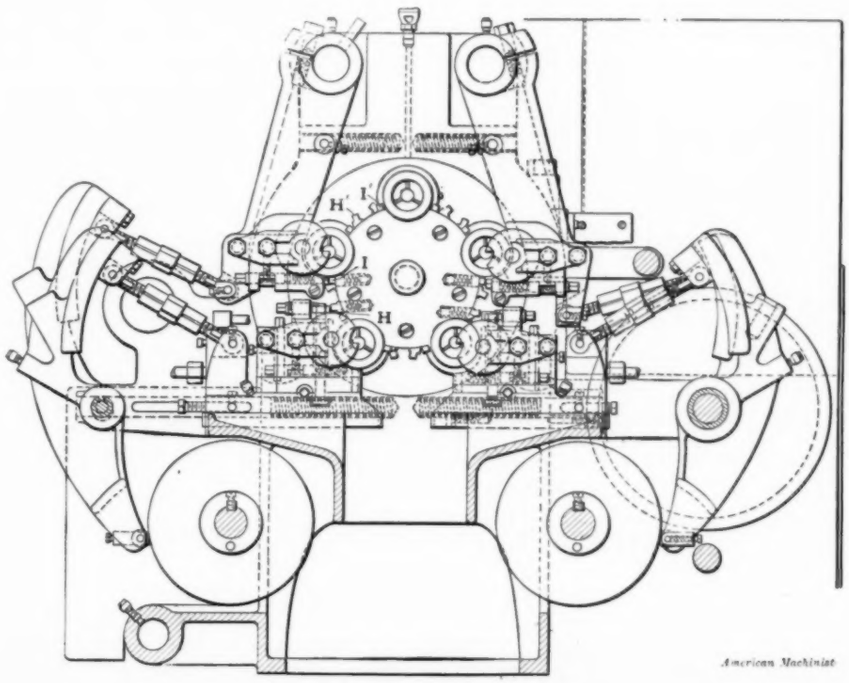


FIG. 9. CROSS-SLIDES AND STOPS

ADVANTAGES OF INDEPENDENT TOOL FEED

In connection with the explanation of the independent feeds for the different cutting tools, the diagram, Fig. 10, should be of interest as it illustrates the advantages of this system of operation. The diagram is self explanatory.

ATTACHMENTS, COUNTERSHAFT, ETC.

This form of construction with independent feeds for the tools, adapts the machine for the ready application of special attachments of various kinds; thus, for drilling small holes an auxiliary spindle for the drill is simply mounted on the end of one of the tool spindles and this is driven by a light round belt passing over a small grooved pulley on the drill spindle and over a larger pulley on the countershaft.

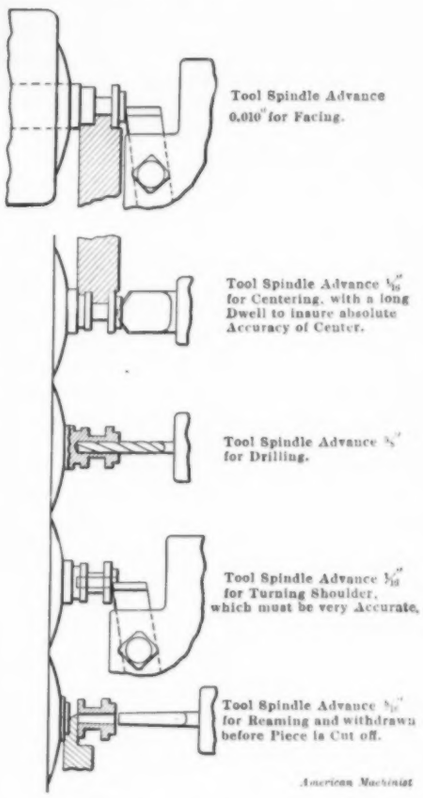

Tool Spindle Advance 0.010" for Facing.
Tool Spindle Advance 1/16" for Centering, with a long Dwell to insure absolute Accuracy of Center.
Tool Spindle Advance 3/8" for Drilling.
Tool Spindle Advance 1/16" for Turning Shoulder, which must be very Accurate.
Tool Spindle Advance 1/32" for Reaming and withdrawn before Piece is Cut off.
American Machinist

FIG. 10. RESULT OF SEPARATE FEED FOR EACH TURRET TOOL

Another interesting attachment which may be mentioned here is in the form of a center punch for putting a clean sharp center in the end of the work machined in the chucks. This center punch is actuated by a spring which normally is under

compression, and when released, causes the punch to strike a light, but quick and effective blow. The holder for the punch is attached to the end of one of the tool spindles and the punch plunger is pressed back against its spring and locked by a trigger engaging a collar on the front end of the device. Upon the punch approaching the end of the work to a predetermined point, the trigger is automatically released and the punch driven into the work.

The countershaft is a plain shaft running in self-oiling hangers with tight and loose pulleys 10 inches diameter for a 4-inch belt. It should run from 400 to 425 revolutions per minute. The machine weighs about 2150 pounds.

Unexpected Results from a Cost System

By S. L. Platt

Every now and then some machine-shop managers, treasurers, secretaries, or whoever are responsible, bewail the fact that the balance sheet does not show the profit they had expected, considering the cost of production given by their cost system. Let us see how this worked out in a particular case.

Installing the Cost System

One manager said, during a conversation on this subject, "I simply cannot understand it; we have as good a cost system as So-and-So, yet he claims their figures give them correct results, while our balance sheet comes out with only a mighty small margin to the good."

On being asked who put the cost system in, he replied, "There's the strange part of it. Our system is the same as So-and So's, for I spent *two* whole days going over their method. Got copies of all their blanks, books, etc., and put the same things in our shop. I know the treasurer over at So-and-So's well. He is a mighty good friend of mine; we lunch together most every day at the club, and as our lines do not conflict, we often have a chance of doing each other a good turn; so you see, I have no reason to doubt his giving me anything but the right thing."

An examination of the cost system would seem to bear out the manager's idea that it was a good one. Time cards covered the information needed, giving the hours, job numbers, piece number, kind of work done, and number of machine used, and whether regular, special or repair. The job and piece numbers were put on by the foreman when the work was given out, and checked by him when finished. The cost-clerk used these cards for his records.

All material used was charged up by the storekeeper on a blank printed for the purpose, which went to the cost department each day, and a carbon copy was kept for his use. He also kept a list of all such finished parts as came back to him, on another blank printed for the purpose. As he practically receipted for the parts by putting his initials on the time card, when the job was finished and handed over to him, it made a good way of checking his records as well as indicating to the timekeeper that that part of the work was completed. Whenever there was a delay between any two departments, the work went back into the storekeeper's care, even if not to his storeroom, and was kept track of by him, a record being made in his daily memorandum, in red ink, to avoid duplicating material charges. This time-card method was carried right straight through, even to the shipping clerk and teamster.

The cost department was presided over by a bright young man who seemed very careful, faithful and anxious to have things right. Cards printed to suit requirements were used for every part—larger ones for summaries—and as these cards were made out from the blueprints, when the orders went into the shop there was very little chance of omission. These same cards were used to compare time of different operators on the same work and to establish a standard. Whenever there was any great difference, the superintendent's attention was drawn to it and an investigation made. This often brought out the fact that a machine needed repairs or adjustment and had been neglected by the foreman; that a casting was imperfect; or a different grade of material, harder to work, had been used, etc., etc.

The Prices Used

Prices for materials—castings, steel, brass, bronze, screws, nuts, bolts, etc.—were given by the purchasing agent, freight, cartage, etc., being included. These were corrected from time to time, and kept right up-to-date. A percentage was added to the actual wages paid the operator, to cover such labor as could not be charged direct. This was taken from the payroll, and frequent adjustments made to meet changed conditions. The different machines—lathes, milling machines, planers, grinders, shapers, drills, etc.—were charged for by the hour. The time was taken from the time cards, the machine being designated on it by number.

Neglected Precautions

From the foregoing it would seem that the cost system was pretty thorough and well taken care of, but that balance sheet told another story, and that story was the one that brought consternation to the manager and the company. If the cost system showed that the profit should be so much, and the balance sheet showed a very different figure—in this case much smaller—one or the other was wrong. But which one?

Having started our examination on the cost system, it appeared best to follow it through before tackling the balance sheet. Studying the matter over, it seemed hard to find a place that gave evidence of being wrong, yet there were one or two spots that could be gone into deeper. Considering the system as a whole, however, it would hardly indicate that they could have slipped up on anything very important.

The first move was to check up the total payroll with the amount charged against the different jobs. This was not as difficult as it might seem, for they ran good-sized lots through on stock orders, but it did not jibe by quite an amount, the cost system being on the short side. The cost clerk was chagrined. It was checked over again with the same result. At this point it came out that such comparisons had never been made before, nor were there any carrying accurate accounts on their books to compare with. The manager had never known, as he put it, "that you could carry on a double-entry cost system, with one foot in the shop and the other in the office. My friend over at So-and-So's either didn't do it in his shop, or else he forgot to tell me." This first move, although it helped, didn't cover all the difference.

The material accounts, a much harder proposition on the whole, having two inventories to consider, and all the chances of shrinkage, etc., came out short, also; but this generally happens and as the amount was not large enough to make up more than a small fraction of the difference, it meant still more hunting. The manager's "Well! what are you going to do now," didn't prove a great help, nor did it, judging from the tone of his voice, seem very encouraging. But the reply brought him up standing, "Throw the cost system you have into the street and put in a real one." It wasn't done, however, even though we all felt like doing it. Everything possible of proof, it seemed, had been proved, yet we hadn't reached a solution. Again things were studied over. Then came the query, how about the charge per hour on those machines? The manager claimed that overhead charges were taken care of that way.

Guessing at Figures

Asking how he arrived at those figures, he said, "I went over these things with the bookkeeper, found out how much our indirect shop and other expense items amounted to, then the superintendent and

I made up that list of charges for machines by the hour as near as we could, thinking we had them high enough." Getting the same figures, as nearly as the bookkeeper could remember—original ones destroyed—the cost of each machine and the average number of hours it was used per day, during the year, the depreciation charges against them, etc., etc., another schedule was made up. It did not agree with the one they had been using, and by averaging and estimating, a difference was shown great enough to account for the contradictory stories told by the cost system and the balance sheet, proving the Irishman's saying that "you always find the thing you are hunting for in the last place you look."

Methods used in one shop are never adapted to another any more than one suit of clothes will fit two different men, even if they do look alike.

It is always best to prove every figure used in a cost system, just as far as possible, and there are very few figures, if any, that cannot be proved in one way or another, if care, thought and study are given them, just as a construction engineer works out his calculations to prove that a bridge is strong enough to bear itself and its load. A manufacturing plant that cannot carry itself and its load, surely never proves a profitable investment.

Some Old Machine Tools

Editorial Correspondence

The McKaig Foundry, Machine and Supply Company, of Cumberland, Md., is one of the oldest machine shops in the country that is still doing business. The shop has been handed down from father to son for three generations, but it is not the old-fashioned, slow-moving, moss-covered shop that is often seen

FIG. 1. PLANER THAT HAS BEEN IN USE OVER 60 YEARS

when they get to be that age. The younger generation are looking for new ways and means of doing work, and are keeping in touch with all improvements as much as, doubtless, was the founder of the plant.

In a shop of this age, one would naturally expect to find some relics of by-gone days, and in this we were not disappointed, as the accompanying illustrations will show. It was hard to locate the exact age of the planer shown in Fig. 1, but it was built by Shriver & Brother, who had a machine shop in Cumberland, Md. This firm went out of business in 1857, so that the planer must have been put in the McKaig shop before that time. The present owner of the shop has been around it as man and boy for something like 50 years, and says the planer has occupied the same floor space that it does now and been in almost daily use as far back as he can remember. It has, doubtless, never seen a railroad train, as Shriver & Brother's and McKaig's machine shops were located close together, and this planer must have been carted and rolled from where it was built to its present position. It is now in daily use, but through a mistake of the photographers, the belts from the driving pulleys to the overhead shaft were erased from the picture. A piece of work had just been taken off of it when the photograph was taken.

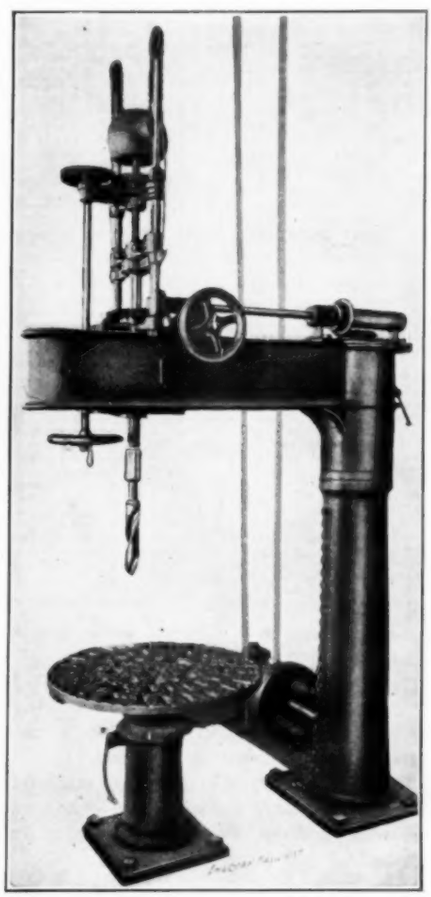


FIG. 2. RADIAL DRILL AFTER 42 YEARS OF USE

The second old tool found was the radial drill shown in Fig. 2. According to the nameplate, this drill was manufactured by R. F. Barr & Co., Wilmington, Del., in 1869, and was shipped to McKaig's shop, where it has been in use ever since. It is still doing a day's work, as the operator took his job off the table so we could get the photographs. The only repairs that have been made on this drill were the replacing of worn out gears, and the rebabbitting of some of the bearings. The table, as will be seen, looks as though it had had smallpox several times, and therefore, it might now be difficult to drill holes to the thousandth of an inch. There is no connection between the table and the column of the drill press, but each is bolted to the floor independently. The table and screw for raising and lowering it, are cast in one piece. This screw is about 8 inches in diameter, and the thread is square with about ½-inch space. The radial arm is not swung on ball bearings, and consequently, is difficult to move; but not beyond the ability of one man to do so, providing he has the proper size and strength.

One should not surmise from these tools that the McKaig shop is not doing good work, as they are equipped with other tools which are modern and accurate. They have recently built some very large accurate machines for polishing shaftings, as well as doing other kinds of general machine-shop work by uptodate methods.

The following recipe for a water-proof glue is given in the *Woodworker*: To about a pint of ordinary glue add ¼ ounce of bichromate of potash dissolved in a little hot water. This glue can be made any consistency that your work requires. It should be kept in the dark as much as possible after being mixed, under which conditions it will remain good for a week or so. It is a little slow in assuming its water-proof character, but when it is set nothing less than a strong acid, which would destroy it, will dissolve it. If it is desired to have the glue pliable, as for gluing a belt, add a little glycerin, when it will always remain flexible.

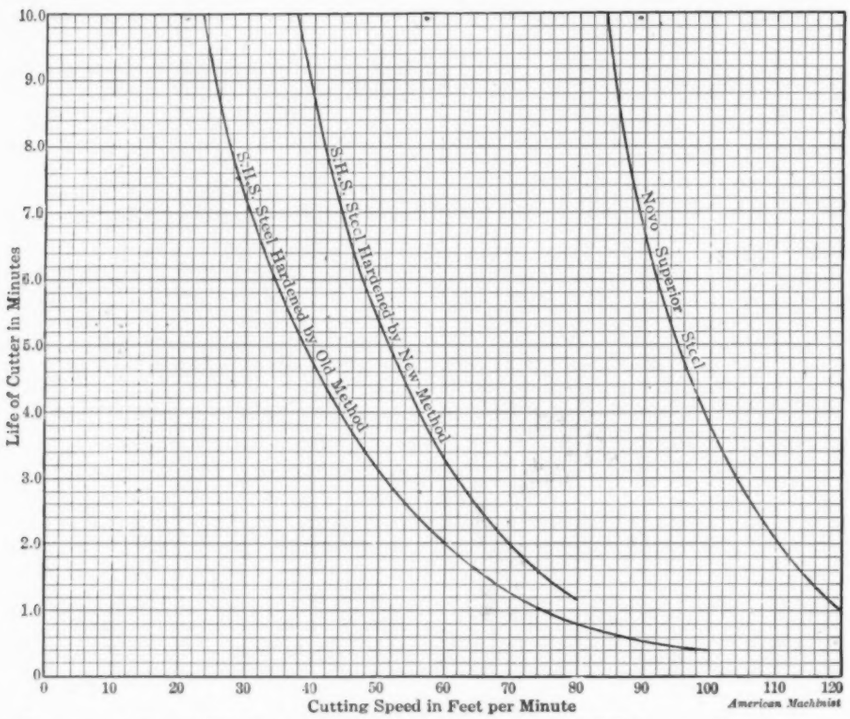
Unusual Results Obtained by the Use of High Speed Steel

A Series of Tests to Determine Its Exact Cutting Capabilities

By C. Berg *

Owing to the difficulties in maintaining the maximum producing capacity of our machinery with the high-speed steel we were using for boring tools on castings made from car-wheel iron, the test to be described was made at the Chicago Works of the Link-Belt Company.

Previous to this test a piece of the Novo Superior steel had been made into a turning tool for a Jones & Lamson flat turret lathe. Although this tool had only received an ordinary hardening (heated to a white heat and dipped in water), it was used in competition with what has been considered, one of the best high-speed steels made in this country and hereafter we will call this "Standard high-speed steel." All work recorded in these tests has been performed on one grinding, as the tools were not allowed to be removed from the machine for regrinding.


Life of Cutter in Minutes
Cutting Speed in Feet per Minute
S.H.S. Steel Hardened by Old Method
S.H.S. Steel Hardened by New Method
Novo Superior Steel
American Machinist

DEPTH OF CUT 7/32 INCH. FEED PER REVOLUTION 0.0339 INCH. RESULTS IN BORING CASTINGS OF CAR-WHEEL IRON

The results were as follows: Test No. 1 with Novo Superior steel. Material turned, 1⅛ inches square rough stock, open-hearth steel, 0.12 per cent. carbon; cutting speed, 115 feet per minute; feed, 0.01 inch per revolution; depth of cut, ⅜ inch maximum and 1/16 inch minimum; length of cut, 1600 lineal inches (133.33 feet); duration of cut, 8 hours; total amount of metal removed, 768.3 cubic inches; condition of tool, had to be reground, started to get blunt.

The finished product, 200 pins, were turned to a gage fit, with 2-inch length drive fit under the head. The first and last pieces were marked and measured with a micrometer and did not vary in size.

The Standard high-speed steel tool hardened as stated previously and put to work under the above described conditions, performed the following amount of work: (2) Length of cut, 400 lineal inches (33.33 feet); duration of cut, 2 hours; total amount of metal removed, 192.07 cubic inches; amount of metal removed per minute, 1.297 cubic inches; condition of tool, had to be reground, slightly injured.

The ratio of work performed by the two steels in this case was as 4 to 1.

After the above results had been obtained, three turning tools of the same kind as described above were made from another bar of the Novo Superior steel. One of these tools was put to work in the machine used previously and under the following conditions: (3) Material, 2-inch shafting, open-hearth steel, 0.15 per cent. carbon; cutting speed, 190 feet per minute; feed, 0.03 inch per revolution; depth of cut, 5/16 inch; length of cut, 48 lineal inches (4 feet); duration of cut, 4.80 minutes; total amount of metal removed, 79.52 cubic inches; amount of metal removed per minute, 16.567 cubic inches; condition of tool, had to be reground, started to ruin.

A Standard high-speed steel tool put to work under above conditions ruined in starting the cut.

In order to perform the above total amount of work, the conditions for the Standard high-speed tool changed to: (4) Cutting speed, 110 feet per minute; feed, 0.03 inch per revolution; duration of cut, 7.7 minutes; amount of metal removed per minute, 10.354 cubic inches; condition of tool, had to be reground, cutting edge wore round and point ruined.

The ratio between the two steels in relation to the producing capacity of machine was as 1.6 to 1.

The second and third tools of these last three made from the Novo Superior steel, were also tried, but with less favorable results. One of these lasted only 0.90 minute, or for 9 inches length of run, under the conditions for Novo Superior as stated in (3) while for the other the conditions had to be changed, and the tool reground did not do any better than the Standard high-speed tool in (4).

HARDENING METHODS

This inconsistency in life of these tools appeared to be directly due to inferior hardening. The old method of hardening (putting the tool in a coal fire in the blacksmith shop) for a steel which requires such high temperature, does not seem to be good enough. In the first place it is very difficult or next to impossible to determine when the proper temperature has been reached, by the color of the heated steel.

Second, the heat is not evenly distributed over the tool, this latter fact being ascertained by a series of observations and tests on tools of the above described type. The tools, which are 5½ inches long, have a cutting edge on each end, and were ground to the standard cutting angles on a Sellers tool grinder, were hardened by the above method, and both ends of the tool were allowed to perform their maximum amount of work under equal conditions, but the difference in life of the two ends of the same tool appeared to be as great as that of two different tools.

The difference between this method of hardening and the new, more scientific way will be referred to later in this paper

*Production engineer, Link-Belt Company.

Test Specimen.	Core, Inches.	Bore, Inches.	Depth of Cut in Inches. (Each End)	Feed per Revolution.	Cutting Speed in Feet per Minute.	Tool Steel.	Total Length of Cut in Inches.	Duration of Cut in Minutes.	Total Cu.In. of Metal Removed.	Per Minute, Cu.In. of Metal Removed.	Ratio of Work Performed.	Condition of Cutter.	Amount of Grinding to Restore Cutter to Proper Angles.	Remarks.
5″x3¼″ solid roller—chilled core....	1 3/16	1 7/16	1/8	0.0339	45.0	N. S.	16¼	4.0	8.125	2.03		no sign of having been used	no grinding required	Highest speed on mill used.
8″x8″ bushing, car-wheel iron.....	5½	5 11/16	3/32	0.0339	100.0	N. S.	8	3.7	31.466	8.50	9.14 / 1	ruined	1/16″	Cutter ruined evenly on both ends.
8″x8″ bushing, car-wheel iron.....	5½	5 11/16	3/32	0.0339	100.0	S. H. S.	1/8	0.4	3.440	8.50		ruined	1/16″	Cutter hardened by old method. Cutting edge on one end melted.
8″x8″ bushing, gray iron.....	5½	5 11/16	3/32	0.0339	190.0	N. S.	8	2.0	62.932	15.73		good	no grinding required	One cutter used for both bushings. The last two inches were exceptionally hard, the casting heated to a dark red under the cutter, and the chips turned to a dark blue when cooled.
8″x8″ bushing, car-wheel iron.....	5½	5 11/16	3/32	0.0339	73.0	N. S.	8	5.1		6.25		ruined	1/32″	
8″x8″ bushing, car-wheel iron.....	5½	5 11/16	3/32	0.0339	73.0	S. H. S.	1¼	1.1	6.890	6.25		ruined	1/16″	Cutter hardened by old method.
8″x8″ bushing, car-wheel iron.....	2½	2 13/16	3/32	0.0339	68.0	N. S.	8	2.7	14.950	5.50	2.04 / 1	ruined	1/32″	Cutter started at 93.0 feet per minute, but started to ruin on ½″ length of run, due to blow holes in end of bushing.
8″x8″ bushing, car-wheel iron.....	2½	2 13/16	3/32	0.0226	50.0	S. H. S.	8	5.5	14.950	2.72		started to ruin	1/64″	Cutter hardened by new method.
8″x8″ bushing, car-wheel iron.....	2½	2 13/16	3/32	0.0339	68.0	N. S.	8	2.7	14.950	5.50	2.21 / 1	ruined	1/32″	Cutter had been used and reground.
8″x8″ bushing, car-wheel iron.....	2½	2 13/16	3/32	0.0339	68.0	S. H. S.	3¾	1.2	6.760	5.50		ruined	1/64″	Cutter hardened by new method.
8″x8″ bushing, car-wheel iron.....	2½	2 13/16	3/32	0.0339	68.0	N. S.	6⅞	5.6	30.600	5.50	4.1 / 1	fair Could be used without re-grinding.	1/64″	Cutter had been used and reground.
8″x8″ bushing, car-wheel iron.....	2½	2 13/16	3/32	0.0339	68.0	S. H. S.	4	1.36	7.480	5.50		ruined	1/32″	Cutter hardened by new method.
8″x8″ bushing, gray iron.....	3	3 1/16	3/32	0.0339	58.0	S. H. S.	8	3.65	70.884	4.85		good	no grinding required	One cutter used for these bushings hardened by new method.
8″x8″ bushing, gray iron.....	3	3 1/16	3/32	0.0339	79.0	S. H. S.	8	2.7		6.56		good	no grinding required	
8″x8″ bushing, car-wheel iron.....	3	3 1/16	3/32	0.0339	31.0	S. H. S.	8	6.9		2.57		fair	no grinding required	
8″x8″ bushing, car-wheel iron.....	3	3 1/16	3/32	0.0339	42.0	S. H. S.	8	5.1		3.48		ruined	1/32″	
8″x8″ bushing, car-wheel iron.....	3	3 1/16	3/32	0.0339	58.0	S. H. S.	8	3.65	17.721	4.85		ruined	1/16″	Hardened by new method.
16″x9½″ flg'd rollers, car-wheel iron	2½	2 13/16	3/32	0.0339	93.0	N. S.	19	4.7	35.50	7.55	9.45 / 1	ruined	1/32″	
16″x9½″ flg'd rollers, car-wheel iron	2½	2 13/16	3/32	0.0339	20.0	S. H. S.	9½	11.2	17.75	1.60		ruined	1/32″	Hardened by old method.
2 15/16″ safety collar, gray iron.....	2¾	2 13/16	3/32	0.0339	93.0	N. S.	398 (33′-2″)	100.0	335.5	3.36	50.0 / 1	fair Could be used without re-grinding.	1/100″	398 pieces finished with one cutter.
2 13/16″ safety collar, gray iron.....	2¾	2 13/16	3/32	0.0339	93.0	S. H. S.	8	2.0	6.72	3.36		ruined	1/32″	Hardened by old method.
2 13/16″ safety collar, gray iron.....				hand-aver. = 0.01″	62.0	N. S.	126 pieces				4.85 / 1	ruined	1/32″	Facing hub with double end facing cutter. S. H. S. cutter hardened by old method.
2 13/16″ safety collar, gray iron.....				hand-aver. = 0.01″	62.0	S. H. S.	26 pieces					ruined	1/32″	

RECORD OF TEST ON BORING CAST IRON WITH NOVO SUPERIOR AND STANDARD HIGH-SPEED STEELS.

and shown more clearly in connection with the hardening of double-end cutters for boring cast iron.

Cutters Used for Tests

Conclusions based on the above experiments, resulted in our getting more Novo Superior steel for test purposes, and making boring tools for cast iron. From two sizes of steel, 5/16x1⅛ inches, and ⅜x1½ inches, double-end cutters were made for several standard sizes of bore.

In order to get a comparative test, cutters from Standard high-speed steel (bar of same size as above) were made, and hardened with the cutters made from Novo Superior steel and put to work on the same class of material. The cutters from the two kinds of steel were marked, "N. S." for Novo Superior, and "S. H. S." for Standard high speed, then heated in a Steele-Harvey crucible melting furnace (the proper kind of hardening furnace not being available), to 2300 degrees Fahrenheit, as measured by a Hoskins pyrometer, and then dipped in oil. The cutters were ground in the ordinary way on the grinder, the standard cutting angles being maintained.

The results of the tests are given in the accompanying table; the kind of high-speed steel being designated by the initials given above. The test specimens used were cast-iron bushings, 8 inches outside diameter and 8 inches long; the cores varying according to the size of the cutters. Some of these bushings were made from ordinary gray iron, and some from car-wheel iron.

Method of Casting the Iron

The car-wheel iron bushings were cast as follows: About five minutes after the iron had been poured into the mold, the core was knocked out and filled with water, thus cooling the casting very rapidly; the bushing being perfectly cool in 30 minutes. Six solid rollers 5 inches outside diameter and 3¼ inches long, were cast from car-wheel iron, with 1 3/16-inch diameter cold-rolled steel cores. The rollers, however, did not get a perfect chilled core on account of the thickness of metal being too great.

A new 34-inch vertical boring mill made by the King Machine Tool Company, was selected for the test and the results recorded in the table. Some of the experiments were run under such equal conditions that the ratio of work performed by the two steels can readily be seen.

Computing the Ratios

The cutter to be considered is not the one which lasts the maximum length of time only, but the one which performs the maximum amount of work in the shortest time. A change in conditions under which the cutter is run will decrease or increase the number of cubic inches of metal removed per minute accordingly. A variation in the total number of cubic inches of metal removed for a constant depth of cut means a decrease or increase in life of cutter as the case might be.

Therefore, the ratios in the record are computed as follows: The ratio of number of cubic inches of metal removed per minute multiplied by the ratio of total number of cubic inches of metal removed. This product gives the true ratio between the two steels of above-mentioned maximum amount of work performed.

Double End Cutters

The last recorded experiments on safety collars shows a comparatively large total amount of metal removed, and it would undoubtedly have been economy to decrease the same and increase the amount of metal removed per minute, but the speed limit of the machine had been reached. The work of the double-end facing cutter recorded in this connection consists practically in scraping the scale smooth on one side of the collar.

It must be remembered that the test specimens made from the car-wheel iron, are of rather unusual quality, and in general everyday practice termed "too hard to machine." The cope end of the bushing, where the cold water struck the metal after pouring, being full of small blow holes, it generally broke out under the cutter for ⅛ inch in length.

Production Capacity

The difference in economy between the two tool steels in the shop is probably best illustrated in the accompanying chart that gives the comparative life of the cutter at the various cutting speeds. The chart also shows the difference between the ordinary "old method" and the scientific "new method" of hardening, that was previously mentioned in this paper.

In connection with producing capacity as shop economy, it might be stated that for the general class of manufacture the boring cutters of Standard high-speed steel are run at a cutting speed of 60 feet per minute for gray iron, and 40 feet per minute for castings from car-wheel iron, and it would be possible to run the boring cutters of Novo Superior steel at 150 and 80 feet per minute respectively, when using the standard feed for rough boring, i.e., 0.0339 inch per revolution, with fully as heavy cut as can be taken with the Standard high-speed cutter under the above conditions.

The difference in cost between the two steels in connection with shop economy is entirely eliminated when the fact is considered that it takes at least four regrindings for a Standard high-speed cutter, practically disabling the same for additional work, to one, for a Novo Superior cutter, for an equal amount of work. The decrease in cost of manufacture by using Novo Superior steel for boring tools, involves the increase of power, wear on machinery, fixed charges, etc., and is beyond the intention of this paper.

Stock Wise—Labor Foolish

By James F. Hobart

A workman who should know better, and a foreman who is paid for looking after things in general are sometimes guilty of time waste, which is ridiculous when one comes to consider the matter. For instance in the shipping department of a machine shop, I recently saw the head of that department trimming up a stencil, with a scissors, which the machine had not cut clean owing to the extreme thinness of the paper. Ordinary thin wrapping paper had been used instead of the strong thick paper provided for the purpose of stencil-cutting.

Upon being asked why he spent so much time on that work, instead of using the regular paper, the workman replied, that he only wanted a very small stencil and used the wrapping paper to save the regular paper. As the man was working 60 hours a week for $16.50, or 458/1000 cent per minute, two minutes were spent trimming the stencil, at a cost of 916/1000 of a cent. The paper, 4 inches wide and 10 inches long weighed 3/16 ounce and at 10 cents a pound cost about 1/10 a cent as nearly as you can figure it. Trying to economize in that way will never prove profitable.

Another instance occurred in a large Eastern railroad. The master mechanic wanted a lot of new ratchet drills at a cost of $3.48 apiece, that being the price for which he could purchase 100 new ones. The directors would not listen to the request, but ordered the master mechanic to rebuild the old ratchets in the shop. This was done, and the cost totaled about $9.80 apiece for the 100 odd rebuilt rachets.

Instances of this kind can be multiplied indefinitely. They indicate that someone connected with the mechanical industry should make it his business to watch each operation performed by each and every man, from general manager down to water boy, and determine if there is not some other way of making those moves which will save one-half the time, or cost a little less for energy expended in moving. Truly, this is the day of small economies; they must be looked after closely or many little losses will creep in.

Compulsory Working of German Patents

*By George Neumann**

The present German patent law dates from April 7, 1891, when it took the place of the patent law of May 25, 1877. It enacts in:

Section 11. After the expiration of three years reckoned from the day of publication following the grant of the patent, according to Section 27, paragraph 1, it shall be revoked:

1. If the patentee neglects to put the invention into practice within the realm to an adequate extent, or at any rate fails to do all that is necessary to assure this practice.

2. If it appears to be required by the public interest that licenses to use the invention be granted to others, but the patentee declines to grant this permission although upon reasonable compensation, and adequate security.

Thus the German Patent Act, in imposing an obligation of working, differs from the original English Statute of Monopolies, of 1623, which is the oldest patent law in the world.

The idea of compulsory working was embodied, however, in the French law of 1762, allowing a year in which to begin the exercise, this period being lengthened, in 1791, to two years of culpable neglect. Other countries followed. After the formation of the German Empire, in 1871, there were some doubts as to a patent policy, but these were resolved in 1877 by the framing of a governmental bill for an Imperial patent act. This regulated the working of the inventions as set forth in Section 11 already quoted, applying therein the following principle:

"The revocation of a patent operates first from the moment in which it is cancelled; it has, therefore, no reactive (automatic) force."

This provision rests on the theory that it is not expedient to facilitate the death of a single granted patent where the general legal requirements have been complied with at the time of its issue. A fruitful growth of inventions would thus be impeded through the insecurity of the owner of a patent that it was valid. The grounds for annulling a patent are, therefore, restricted as greatly as possible.

This revocation does not take place as the necessary consequence of certain facts designated in the law, but may be put into effect where, in the presence of such facts, the cancellation of the patent is considered necessary by the authorities. The possibility of the revocation is, therefore, a means of warning the patentee that a condition may exist in which it will be necessary.

In the current German legislation, the revocation of a patent is dependent, among other things, upon a patentee's neglect to exercise the patent right, inside the country, within a certain period. The rule has not turned out as was hoped but has proved generally inadequate.

It is possible to "work" an invention in some simplified manner which does not carry out the spirit of the law to public advantage. The Government lacks proper means to make reliable determinations on this question of working. Such a definition as we have affords no guarantee that the use of the invention is not lost to the country. In that respect, therefore, the plan has failed.

Of course, the State cannot leave entirely to the judgment of the patentee whether, and upon what terms, he shall dispose of his patent. There is a danger that he will consider only his personal interests and neglect those of the public. The risk of a misuse is greater, and the evil consequences thereof become the more acute, the longer the duration of the patent under the law and the more competition enters from abroad. A patent ought not so to be employed that the public productive and competitive conditions become unnaturally distorted. Safeguards against misconduct were, therefore, deemed necessary.

Such improper practice can enter in a two-fold manner. First, in this way: that the patentee retains the domestic use of the patent exclusively to himself and denies it to others who need it for their business. If the invention be of such sort that it materially affects labor conditions, the patentee is thereby protected against competition of other manufacturers, sometimes even menacing them with ruin and creating for himself a monopoly. The improper use of the patent may, instead, consist in this: that the patentee does not put the invention into general use within the country, either himself or through another manufacturer, but prefers to reserve the patented industry entirely for foreign use, in order to supply the inland market with products made abroad. In this way also, as the invention reacts upon the manufacturing situation, the life of domestic industries is jeopardized, whereby again the patentee may acquire a virtual monopoly, and even a worse one than in the former case, to the advantage of the foreign country and to the cost of domestic business. Fortunately conditions of trade seldom permit a full carrying out of this assumption. Nevertheless, even if partially and briefly, a force may be at work to distort normal competitive conditions in opposition to public welfare.

The provisions in clauses 1 and 2 are therefore intended to counteract a misuse of the patent protection in the two directions here explained. Clause 1 is intended to prevent a greater or less domestic monopoly by the patentee. Clause 2 is to hinder its use detrimentally to the country in favor of foreign lands. Both provisions are inactive during the first three years (the prospectus of the law named two years) for should the patent be misemployed within such time, no such great harm could accrue to public interests as to necessitate a revocation before the end of the period.

The first provision springs from an assumption that manufacturers will feel a need to use the invention. But if, after the failure of overtures to that end, the offer made to the patentee and by him rejected, appears reasonable, the authorities are still not obliged to cancel the patent. Whether he has so put the country to disadvantage as against foreign lands that grounds for such revocation do exist, is difficult legally to determine.

Some Distinctions Illustrated in Actual Cases

The German Patent Office and the Imperial Courts, which in the first and second instance are called to consider offers for, and revocations of, patents, have disregarded neither the public good nor the right of the patentee. This is illustrated by the following decisions in actual cases.

A

In order to prevent the revocation, it is sufficient that the subject of invention be brought materially into practice. Immaterial deviations from the patent description are not to be considered.

The Patent Office refused to cancel patent No. 7113, "improvements of rolling mills." It said: "The essence of claim 1 resides in the movable position of a roll which, by means of a lever system, is pressed against a fixed roll in such manner that the former can be separated from the latter so far as is necessary, in order to allow the passage through of hard substances without damage to the rolls. In this element of construction, which is to be considered essential, the roll bench described by Kick and built by Gans & Co., agrees with claim 1. To the number of lever transmissions by means of which the mutually pressed rolls are operated, importance is attached neither in the patent description nor in the phraseology of claim 1. If, therefore, in carrying out claim 1, instead of the complicated lever transmission here provided for, a simple one is brought into use, this circumstance cannot be maintained against the patentee. . . .

"Claim 2 protects . . . a construction, namely, porcelain rolls in roll benches. This construction the defendant has not manufactured at home in the quantity required, and the period of three years has expired. So far as the statutory provisions are concerned, this might lead

*Patent attorney, Berlin, Germany.

to a revocation. The Patent Office has, however, found in this case, no occasion for availing of the authority thus granted to it. There has been, first, the controlling consideration that patent No. 7113 presents a unit invention whose . . . component parts, for the purpose of their clearer delineation, are separately expressed in two patent claims. From this point of view, it is . . . sufficient to regard the manufacture as one, in order to excuse the failure to put the other part into practice. Thus we cannot . . . require of a patentee, from considerations of cheapness, especially when he is domiciled abroad, that he manufacture the patented invention in all its parts in this country.

"The law had an eye . . . to the progress of German economic interests. . . . In the present case, however, the crucial point of economic significance for home industries, in the device protected by claim 2, lies not in its manufacture but in its use. It is notorious that the introduction of the W-porcelain rolls into the German milling industry has come to pass extraordinarily; and indeed this advantage is so important that, in comparison with it, the economic benefit which the country might expect from the manufacture of the rolls at home is of relatively little weight."

B

If there be worked only one among several varieties of construction set forth in the patent claim, or only the invention protected in the supplementary patent, and even if all asserted results do not enter, no revocation need be granted.

Cancellation of patent No. 61,345, "automatic fare register" was refused on the following ground: . "The Imperial Court entertains no idea that the invention of claim 1, in the form of claims 2 to 4, was worked, and worked to a sufficient extent. . . . This state of affairs affords . . . no occasion to make use of the authority conferred in section 11, clause 1 of the Patent Act to revoke patent claim 1 even partially.

C

The Patent Act makes the authority of the cancellation, section 11, clause 2, dependent upon "public interest." The revocation will be denied even, among other circumstances, when the working of the invention takes place only abroad and not at home and only by a system of rental (within the country).

On May 27, 1907, was handed down a decision of the Imperial Court that patent No. 105,762, "machine to cover the sewing edges of inner soles with a reinforcement" should not be cancelled. "The fact alone that the owner of a mechanical patent merely hires out the machine made according to it will not suffice for cancellation of the patent according to section 11, clause 1 of the Patent Act, when it appears that the hiring system brings economic advantage through the domestic production of goods by the machine. That in itself the plan of using the machine by rental rests upon a sound economic idea, cannot properly be doubted." The court proceeded to cite statistics showing that the renting agreements of this sort in the business of a party here interested were numbered by the thousand. It declared revocation in this case to be out of the question.

D

Under what circumstances the authorities have cause to cancel patents, is indicated by the following decision: Patent No. 55,020, "winding machine" was cancelled December 4, 1907, by decision of the Imperial Court, which said: "The machine in question now sells for a price of not less than 6000 marks and therefore it cannot be denied that domestic industry has a considerable interest in its manufacture. Such manufacture has not hitherto taken place, but the machine is only imported from abroad, hence the plea of the plaintiff shall be granted, if the defendant cannot maintain special ground upon which the failure to manufacture at home can be justified. . . .

"Section 11 of the Patent Act requires, so far as possible, the manufacture of the invention at home. The patentee is consequently obligated thereto, even at the sacrifice of an advantage; he should not delay until the domestic manufacture becomes renumerative and must, on his part, make it appear that he has made earnest endeavors. The defendant therefore should not have attached preponderant importance to the fact that a more extensive use has been obtained through the manufacture of his machines in America, but should have presented conditions of license acceptable to domestic manufacturers. That he could have found no licensees, cannot be accepted as proven.

E

Offers to sell or license do not constitute the working of an invention.

In one case the Court explained that, while closing of license contracts affording assurance that an invention would be exploited in the country, sufficed, this was not true of a mere readiness, even if publicly expressed, or of negotiations that miscarried and whose failure was not shown to be due to indifference of the other parties.

In regard to patent No. 23,953, "improvements in machines for reducing soft and yielding substances," the court ignored certain negotiations which had been made after issuance of the complaint in order to furnish proof that the machine could not be made in Germany for the American price. Examining a contract which the defendant had made for the construction and use of certain sizes, etc., in Germany, the court found that he had reserved the more important sizes and was supplying them, to a great value, from America. Revocation was decreed.

Patent No. 104,556, "shoe-sewing-machine appliance for varying the distance of the stitches from the edge of the sole" was cancelled, the machines having been made abroad and imported. After issuance of the complaint, their manufacture had begun in Germany, but only for lease to the limited circle using a sewing machine of a certain system. Here also the patent was revoked.

F

The revocation of a patent may be threatened if the holder of an improvement upon the invention be refused the use of the patent under a suitable license agreement, with compensation.

G

A change of ownership taking place during the period of working does not exclude the right of revocation against a later proprietor.

It may be remarked in passing that, in a typical case where this question was involved, the fact that the earlier holder was engaged in American litigation over the invention was held to excuse his failure to work it meanwhile in Germany.

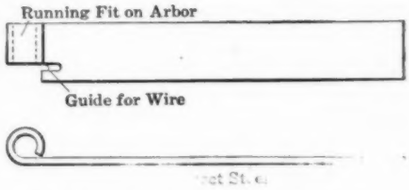
H

Partial revocation is permissible. This is only true, however, where the patent is divisible in its nature.

Winding Springs Rapidly in the Lathe

By C. T. Schaefer

In automobile manufacturing quite a number of springs are used and sometimes there are springs that have to be wound in the factory, instead of ordering them from spring manufacturers, as this usually means a delay of from 2 to 3 weeks.



Winding Springs in the Lathe

A simple little fixture is shown in the sketch, made of ⅛x1-inch sheet steel. An arbor is placed in the lathe, supported between centers, the fixture slid on the arbor and the spring wound. One end of the arbor has a drilled hole to hold wire when starting to wind spring.

A close- or open-wound spring can be made in this way.

Amsler Hardness Testing Machine and Cone Attachment

We illustrate herewith the hydraulic machine manufactured by J. Amsler-Laffon & Sohn, Schaffhausen, Switzerland, for testing the hardness of steel or other metal by the Brinell ball method; also an appliance, which may be used with this machine, for employing the Ludwik cone method.

To obtain the hardness of steel by the Brinell method, as our readers already are aware, it is necessary to embed in the metal a hardened steel ball and to measure the depth of the imprint produced by the pressure acting upon the ball.

This machine, as shown in Fig. 1, is a hydraulic press, in the cylinder of which a piston is forced upward by an oil pump. The piston is frictionless, and without a cup-leather packing. This piston carries a platen on which the test piece is placed. At the lower end of a screw above it is placed the steel ball to be pressed against the test piece, through the agency of the pump fixed

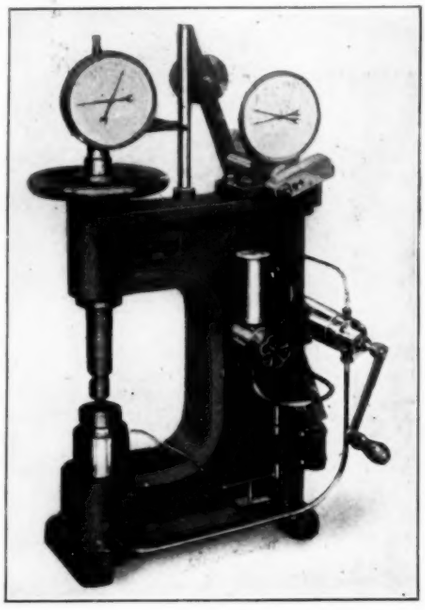


FIG. 1. MACHINE FOR TESTING HARDNESS

at the right hand of the frame. The screw can be raised or lowered by a handwheel to accommodate the size of the test piece.

The pump is a double-acting helicoidal, differential. It sucks the oil from a receiver, beneath which is a valve to let the oil back from the cylinder under the weight of the piston.

MEASURING APPARATUS

The piston pressure is measured by a pendulum manometer and read on a dial, in front of which move two needles, one giving the pressure at the instant, and the other the maximum pressure reached. By adjusting a rider along the pendulum the sensitiveness can be modified. The different marks on the rod correspond to intervals of pressure of 5000, 2500, 1000 and 500 kilograms. At the upper end of the screw, which does not turn during the adjustment, is attached a scale to indicate the depth of the imprint.

This dial scale is divided into 500 parts, each division corresponding to 0.01 of a millimeter. The lines are about one millimeter apart, so that hundredths of a millimeter may be read without difficulty. The depth of the imprint is transmitted to the indicating mechanism by a rod

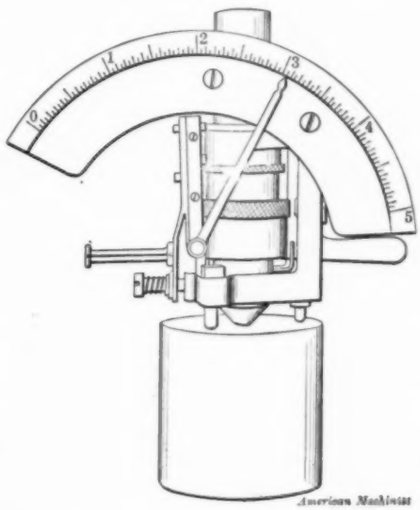


FIG. 2. LUDWIK CONE ATTACHMENT

inside of the screw. This rod is supported by a socket or bushing which surrounds the ball and rests upon the surface of the test piece during the penetration thereinto. The ball remains in place while the collar is raised by the test piece according to the penetration of the ball into it. There is no sliding register on this dial.

The elastic flexure of the frame has no influence on the measuring apparatus, although the elastic distortions of the ball and the screw do have; but to a slight extent. To render them harmless the ball is unloaded before taking a reading of depth, by a brief opening of the valve for the expulsion of oil. To obtain comparable results, it is recommended that the pressure be exerted for a definite length of time during all the tests; for example, 15 seconds.

The greatest available distance between the pressure plate and the ball is 25 centimeters, and the maximum opening between the ball and the frame is also 25 centimeters. With each machine are furnished five balls of diameters of 5, 7½, 10, 15 and 19 millimeters.

CONE APPARATUS

The Ludwik device for testing hardness by means of cones, as shown in Fig. 2, may be applied to the machine in question, and perhaps to other types of machines as well. In this case the ball is replaced by a conical point which is forced into the test piece. This cone has

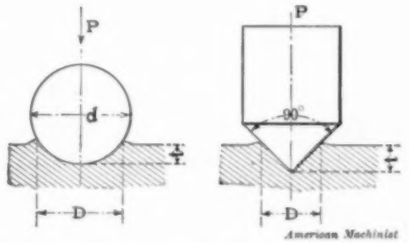


FIG. 3. INDENTATIONS MADE BY BALL AND CONE

an angle of 90 degrees. The formula employed is as follows:

$$H = \frac{\text{Pressure in kilograms}}{\text{Area of the permanent impression in square mm.}} = 0.225\,\frac{P}{t^2},$$

where H is the hardness by pressure, P the pressure in kilograms and t the depth of the imprint in millimeters. Fig. 3 shows these and the form of indentation made by pressing the ball and cone into the metal.

The appliance measures conveniently and exactly the depth of the imprint. As a rule, a pressure of 5000 kilograms is sufficient. The attachment itself does not embody the means of producing or measuring the power. It is composed essentially of a steel punch, conically pointed and vertically guided. Its displacement in relation to the guide is transmitted to a needle which directly indicates upon a scale the comparative displacement.

This guide is in a frame and is placed upon the sample. The punch carries a threaded bushing with which meshes a little toothed wheel fixed to the pivot of the needle. As the punch is pressed into the test piece the needle moves from left to right and gives the depth of the imprint if it has previously been brought to zero. The scale suffices to indicate five millimeters of depth. The smallest division corresponds to 1/20 of a millimeter displacement of the punch. Hundredths of a millimeter are easily estimated. On the threaded bushing is placed a second bushing carrying an index mark. This bushing allows us to detect, whether during the experiment, there has been a rotation of the threaded bushing. It further enables us to determine whether the steel point becomes blunted during a test.

The coarse adjustment of the needle to zero is done by rotating the needle itself, its axis being drawn backward by means of a special button, after which the fine adjustment is made by turning the threaded bushing.

The weight of the punch is approximately balanced by the flat spring, which is visible at the right, near the bottom. The bushing is held upon the punch by elastic friction, so that it can be changed without difficulty. An extra punch goes with the appliance. The hight of the punch is about four inches and the complete apparatus weighs approximately one and one-half pounds. This cone attachment may also be used with a ball for testing by the Brinell method.

Cutting an Unusually Accurate Worm Wheel *By C. W. Klages*

The illustration shows a worm wheel of 360 teeth, 5/8-inch pitch, 71.620-inch pitch diameter. The worm engaging it is 3 inches outside diameter, single thread.

The cutting and hobbing of this wheel was done in a very unusual manner, made necessary by circumstances, and the necessity of great accuracy, as it was intended to be used to drive a large telescope.

The wheel could not be hobbed upon the largest machine available for that purpose as the worm wheel, being of large diameter, would strike the collar of the hob spindle before it could come into contact with the hob, also it was not possible to gear the hobbing machine for a ratio of 360 to 1.

The cutting was done as follows: The wheel was placed upon a hobbing machine geared to cut 180 teeth and a fly cutter about twice the diameter of the worm was used to cut 180 notches in the wheel; the notches produced by this cutter having practically the same angle of spiral as the thread upon the 3-inch diameter worm. The wheel was fed against the cutter slowly by hand until the notches were cut about 1/4 inch deep. The fly cutter was then rotated upon its arbor 1/2 turn so as to cut 180 notches between those first cut, thereby producing 360 notches as a guide for the hobbing which followed.

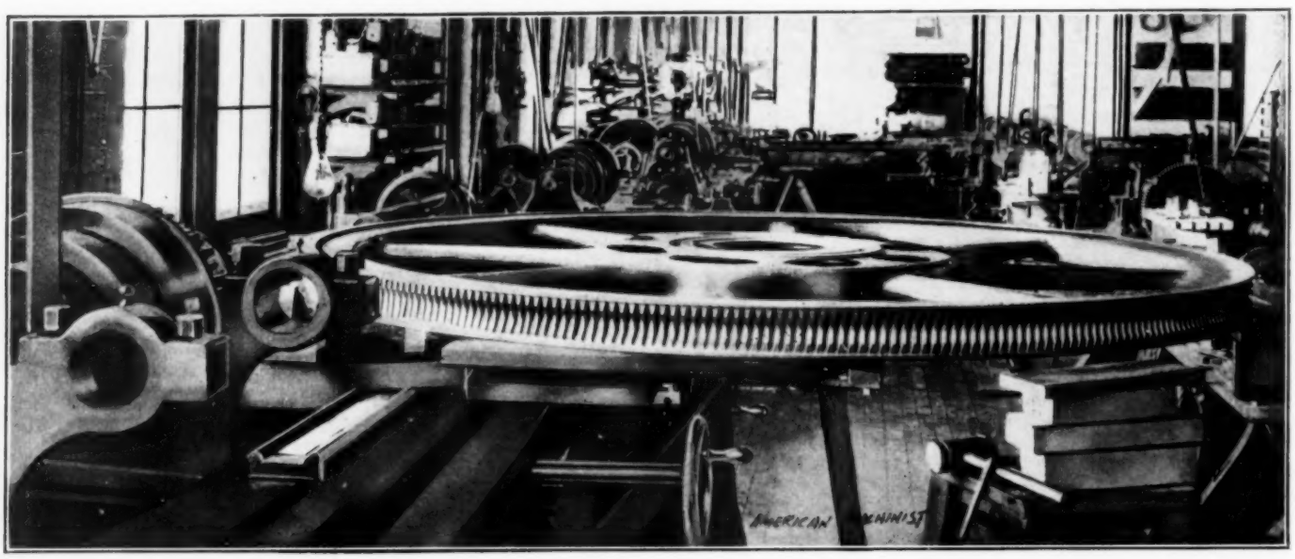
The hobbing was done in a lathe as shown, the worm wheel being mounted upon a special plate, planed to fit upon the lathe carriage. A bushing tapered on the outside to fit the taper bore of the worm wheel was mounted upon the plate with four bolts to hold it down, and four set screws to raise it, so as to permit a little vertical adjustment. The hub of the wheel rested upon three brass blocks resting upon set screws by which the fit of the wheel upon the bushing could be adjusted. The hob was carried upon an arbor upon the lathe centers, and of sufficient length to allow the worm wheel to clear the headstock.

This worm wheel was designed with a loose ring occupying one-half the face of the wheel and held to the wheel by 24 cap screws which permit of changing its position 24 times. This ring was rotated one-half turn showing 1/16-inch average error in the original spacing before the beginning of the hobbing.

After hobbing around two or three times, the ring was turned 11/24 of a revolution; and after having changed the position of the ring 14 times and hobbing a little each time, the teeth were cut full depth, and the rotation of the ring showed no error of spacing or coincidence of the teeth in ring and wheel exceeding 0.003 inch.

The grinding was next done with a worm wheel 24 inches long and mounted in place of the hob. No. 180 emery mixed with oil was used, and after grinding and changing the position of the loose ring a number of times, the error in the spacing of the teeth did not exceed 0.001 inch, or six seconds of arc approximately.

The hobbing and grinding of this wheel was done at the shop of the John A. Brashear Company, Ltd., and the wheel will be used to drive the 30-inch refractor of the Allegheny Observatory.



CUTTING AN UNUSUALLY ACCURATE WORM WHEEL

A good test for oil is to place single drops in line upon a piece of plate glass about 8 inches wide and 24 to 30 inches long, one end being raised about 6 to 8 inches, to form an inclined plane. The drops of oil start from the top of this inclined plane upon a race with each other. The first day sperm oil will be found in the rear, but after a while it will catch up and overtake the rest. An oil having a light body runs quickly and dries quickly, but an oil that has both a body and a free flow will readily be detected by this test. An oil may have a good body and yet may have a tendency to gum badly, which quality will also be easily detected upon the glass. The oils should be covered from dust while these tests are being made.

Action and Design of Four Cycle Marine Gas Engines

Various Forms of Combustion Chambers Valves, Piston Heads

By Albert H. Ziegler *

After having determined upon the required size of cylinder, piston and rotative speeds, and compression volume for a definite horsepower and class of marine gas engine, certain conclusions must be arrived at before the actual drafting of the cylinder can be begun; such as the most advisable general form of combustion chamber, the most serviceable and convenient location and form of construction of the valves and their operating rigging, and the most efficient and compact arrangements and systems of gas and water inlet and discharge piping, all of which will be best suited to that particular class and horsepower output of engine.

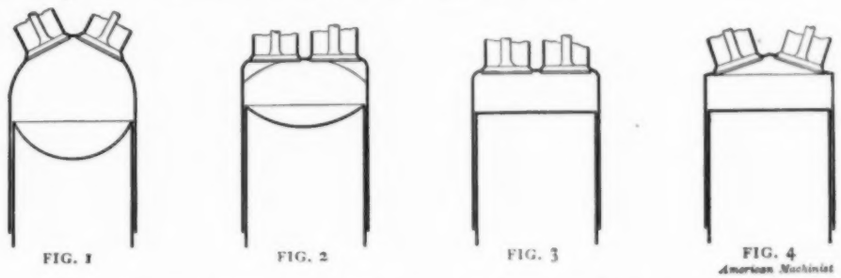
As the general conditions existing in the various classes and sizes of marine engines differ sufficiently to render features most inadvisable and impractical for one class and size, which may be very advisable and even necessary in another, all decisions on such features should be arrived at only after thorough consideration of the effect upon the thermal and mechanical efficiency, as a whole and in detail, also accessibility, lasting qualities, reasonable compactness, appearance, allowable first cost, weight, reliability, etc. The relative importance of each of these requisites, one over the other, must be fixed at somewhat different values according to the class and size of engine required.

As to combustion chambers, it should be remembered that whereas an approximately spherical shape is, theoretically, more efficient thermally than a very irregular, flat, and pocketed one—due to the smaller proportion of water-cooled surface per unit of volume—yet in actual practice the spherically shaped combustion chamber is barely practical, even in very small cylinders employing comparatively low compression pressures and piston speeds. In engines where the cylinders are comparatively large and where fairly high compression pressures and piston speeds exist, the spherical combustion chamber will prove most unreliable due to the great inherent tendency toward self ignition.

To correct this fault in such an engine, the form of combustion chamber must be altered; otherwise the compression pressure would have to be so lowered to secure reliability, that the slight gain in thermal efficiency due to small expanse of water-jacketed surface would be overbalanced by the thermal loss due to the reduction of compression. This reduction of compression will also lower the horsepower output per pound of engine.

Theory, practice, and exhaustive research, have definitely proved that the convection of heat through air and other gases is very sluggish as compared to the convection of heat through most liquids and metals. This fact is exemplified by the greater heat insulating qualities of those boiler laggings which contain the greatest quantities of confined air in their make up. As a result of this slow convection of heat through the gases in the marine engine cylinder, those portions of the charge which are in direct contact with the walls are cooled very efficiently during compression, but the center part of the charge, especially in large cylinders and at high piston speeds, will be practically entirely uncooled and is subjected to the temperatures of adiabatic compression.

Were it possible to expose a relatively large water-cooled surface to the charge under compression, and then greatly reduce or entirely eliminate this cooled surface or even present a hot surface to the exploded and expanding charge in the same cylinder, without appreciably complicating the mechanism or increasing either the fluid or mechanical friction losses, a considerable increase in the thermal efficiency and reduction of weight in internal combustion engines would be assured. However, actual practice of today, at least, knows no such arrangement and the question of the advisable proportion of water jacketed surface per unit of volume, according to the class of engine and compression allowable, must still be contended with.



FORMS OF GAS-ENGINE CYLINDER COMBUSTION CHAMBERS

INCREASE OF POWER OUTPUT

Therefore, in heavy engines where thick and hot walls give rise to high initial temperatures of the charge to be compressed, especially when large cylinder dimensions and high piston speeds make effectual cooling most difficult, the temperature of the center part of the charge may easily rise to the point of self ignition, or will at least greatly increase the liability of self ignition when in combination with other causes such as an overheated piston top or valve, glowing scales of carbonized oil, or even indifferently cooled metal corners or projections in the combustion chamber. An increase of effectual water-jacketed surface in such a case, though insuring a greater direct loss of heat during combustion and expansion, may readily insure a sufficient thermal gain through the increase of compression thus made possible to more than offset the water-jacket loss, and at the same time will increase power output per pound of engine.

PERFECTLY SPHERICAL COMBUSTION CHAMBER

In order to apply the perfectly spherical combustion chamber as is shown in Fig. 1 to even very small sizes of cylinders, the diameter of bore must necessarily be a small fraction of the length of stroke in order to reduce the diameter of the sphere, and thereby the volume of such a spherical combustion chamber, to a figure which will give even as low a compression as 50 pounds per square inch. The length of stroke would be so great in proportion to the diameter of the bore as to make the engine impractical for marine work, were the perfectly spherical chamber utilized.

The excessively concave piston top, Fig. 1, will rapidly overheat as the full load is thrown on, unless water jacketing of the piston is resorted to. This, however, is an unjustifiable expense in engines small enough to employ the spherical combustion chamber. The great expanse of highly heated piston top is sure to affect the safe limit of compression that may be carried at full load. The overheated piston top edge will help carbonize the lubricating oil on the cylinder walls. Some of this carbonized oil will

*Chief draftsman, Standard Motor Construction Company.

work into the ring slots and stick the rings causing a leaky piston, and some will form into glowing piles and flakes on the piston top causing serious pre-ignition. The inclined valves as shown in Fig. 1 will be subject to uneven wear upon the stems and seats, and will soon become leaky. Unless the cylinder is very small the heat of compression in the center of the initially heated charge is liable to cause self ignition. Such an engine is sure to be most unreliable.

Various Modifications

A modification of this type of combustion chamber, which closely approximates the spherical form, allows of reasonably small compression space volumes in engines having comparatively short strokes, reduces the expanse of hot piston top, modifies the overheating of the piston top edge, and allows of a vertical arrangement of the valves thus insuring more even wear and freedom from leakage, is shown in Fig. 2. A still further modification is shown in Fig. 3.

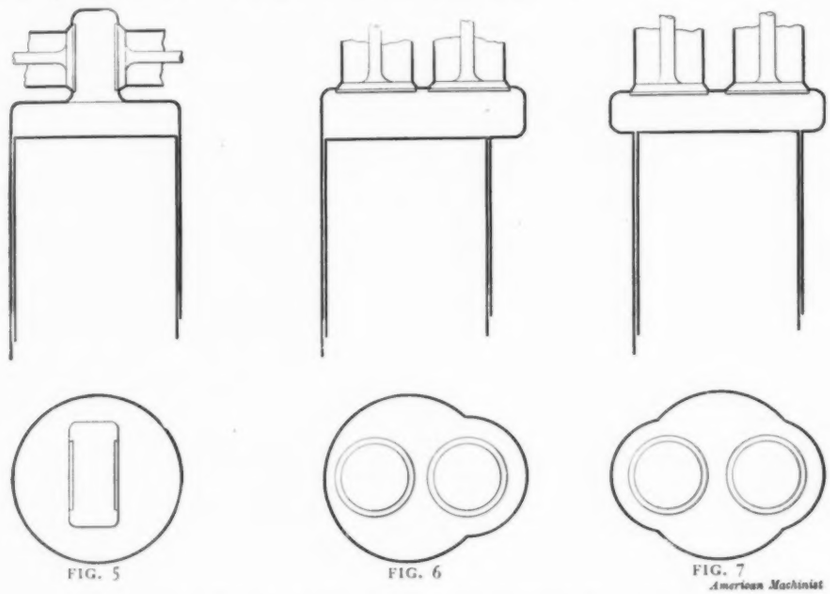


FIG. 5 FIG. 6 FIG. 7

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Other Forms of Gas-engine Combustion Chambers

Excepting in small engines in which very low piston speeds are employed it is difficult to place, within the diameter of the cylinder bore, two well designed valves of a diameter which will insure a reasonable gas velocity through them. It is especially difficult to secure any water jacket whatever between the two valve passages above the valves, unless these valves are inclined as in Fig. 4, a practice to be shunned when at all possible. Without this small amount of water jacketing between the valve passages, the incoming charge is unnecessarily preheated, and destructive unequal expansion stresses are set up in the casting; also the valve seats are subjected to more or less warping: These troubles in such cylinders, shown in Figs. 3 and 4, rapidly increase as the diameter of the cylinder increases.

Concave piston heads, shown in Figs. 1 and 2, not only easily overheat, but in vertical engines act as basins to hold excess lubricating oil which is fried off into smoke, making the exhaust gases obnoxious. A part of this oil is eventually carbonized into incandescent flakes and points, causing premature ignition and back-firing through the inlet pipe. The latter troubles are not positively eliminated in this case even though the compression pressure be very considerably reduced. The concave piston top is essentially a very poor one for marine engine work and should never be employed, in vertical engines at least, and only a very slight concavity for strength should be countenanced even in the horizontal type, which, however, is seldom found in marine-engine practice. The convex piston top is another matter as is explained further on.

The combustion chamber shown in Fig. 5, though materially increasing the water-jacketed surface, will allow of high compressions even in fairly large engines and can be equably cooled, but for vertical engines, it is a poor arrangement on account of the horizontally arranged valves. In the horizontal type engine this combustion space and valve arrangement is very good, even in very large cylinders.

Figs. 6 and 7 show modifications of Fig. 2 which, though adding to the expanse of water-cooled surface, become more reliable for that very reason. These two forms of combustion chambers are adaptable to small and some medium-sized heavy-duty cylinders. These two arrangements also allow of the application of the larger valves required for the higher piston speeds and admit of an ample water space between valve passages, even though the valves are mounted in cages and though the inlet valves are large ones of the automatic type.

Figs. 8 and 9 are modifications of Fig. 5, allowing the use of vertically acting valves, of as large a size as the designer may wish, and insure large and free water spaces around all parts of the combustion chamber. These types are excellent for even the large sizes of heavy duty and for the medium size semi-speed cylinders. In such cylinders the upper valve is preferably the inlet and of the automatic type.

For fairly large heavy-duty, medium-size, semi-speed and small racing type engine cylinders, especially when both inlet and exhaust valves are to be mechanically operated, two very reliable and convenient forms of combustion chambers with their valve arrangements are shown in Figs. 10 and 11. These forms of combustion chambers are especially free from all self-ignition troubles, even at the higher compression pressures and piston speeds.

Fig. 10 involves a somewhat smaller expanse of water-jacketed surface than Fig. 11 and yet does not produce any greater liability of self-ignition, provided the vertical hights of the valve chambers in each are the same. Therefore, the thermal efficiency of Fig. 10 is slightly higher than in Fig. 11.

In Fig. 10 but one camshaft is required; a weight-saving feature of importance in racing, small and medium size semi-speed engines. The cost, too, will be somewhat less. However, for the medium and large sizes of heavy-duty and large semi-speed engines the use of one cam shaft entails a considerable sacrifice of accessibility because of the necessary crowding of valve-gear parts, exhaust and inlet piping, and ignition rigging when of the make-and-break type. As medium and large size heavy-duty, also large size semi-speed type engines are usually of the compressed-air starting type, necessitating the addition of compressed-air valve rigging on at least some, if not all of the cylinders, also a double set of cams on a shifting cam shaft, the type shown in Fig. 10 is very inadvisable, in fact, often impossible, and Fig. 11 must be resorted to. With this arrangement a great degree of accessibility is insured. The engine becomes symmetrical, the inlet and exhaust piping do not interfere with each other, cams and valve rigging may be made amply large, and assembling and valve setting are much more easily accomplished.

In short-stroke engines of this type, however, it may become necessary to raise the piston so high into the combustion space in the effort to reduce compression volume to a high-pressure figure, that nearly all this volume is contained in the valve passages, almost cutting off the flame communication between them. As a result the velocity of flame travel may be so reduced as to make double ignition necessary, one ignition in

each valve chamber and firing simultaneously. With two simultaneous ignitions in two chambers so small, the flame travel will be sufficiently faster than the flame travel in the large combustion chamber of Fig. 10, with single ignition, as to actually show a difference of mean effective pressure on the indicator cards, and in actual horsepower output on the brake in favor of Fig. 11. This increase becomes most decided in cylinders of 12 inches bore and over.

It might be mentioned that small marine-engine cylinders as heretofore mentioned are cylinders of 6 inches bore and under; medium size cylinders are between 6 and 10 inches bore, while large cylinders are those over 10 inches bore.

The Piston

For the sake of reliability cylinders of 10 inches bore and over in marine-engine work, should properly contain pistons the heads of which are water-cooled, whether the engine is meant for either heavy-duty, semi-speed or racing work.

Below 10 inches diameter, a judicious ribbing or pinning of the under side of the piston top may be made sufficiently effective, especially as the allowable first cost generally prohibits the necessarily expensive link-motion, water-circulation piping required by water-jacketed pistons.

Also in large cylinders of all classes, especially when 12 inches in diameter or over, and when fairly high piston speeds and compressions are required, the valves become so large that their great heat is a

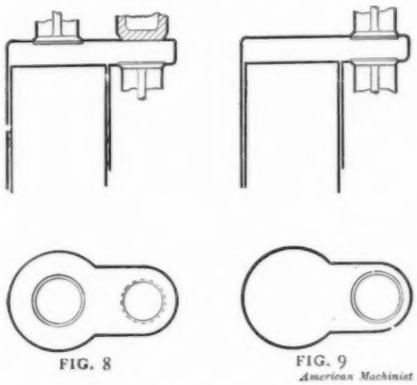

FIG. 8 FIG. 9

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Modification of Arrangement of Fig. 5

very productive source of trouble as regards the tendency toward pre-heating of the charge and self ignition. Also the great size of the exhaust valves working against the terminal pressure, produces enormous stresses in the exhaust valve gear and camshaft rigging. On account of the latter condition it is advisable to apply the balanced exhaust valve, thus reducing the area against which the terminal pressure acts at the opening of the valve. Making this a water-jacketed valve and, for the sake of interchangeability, uniformity of design and low cost of production, utilizing the same valve and operating parts on the inlet side of the engine in connection with a water-jacketed piston, a type of engine is produced which, for cylinders 12 inches in diameter and over, will very efficiently carry a high compression pressure at high piston speed, and produce a large horsepower output, in as reliable and constant a manner as may be demanded under any conditions met with in large heavy-duty, semi-speed or racing-machine engines. Such a cylinder is shown in Fig. 12.

Should the stroke be very long in an extremely large cylinder, allowing a considerable vertical distance between the piston top and cylinder head, adiabatic compression produces a consequent great increase in temperature at this point, and the piston top and cylinder head should be so dished, both in the same direction preferably upward, so that a very material addition to the water-jacketed expanse is exposed to these gases, in a great measure if not entirely, overcoming the difficulty.

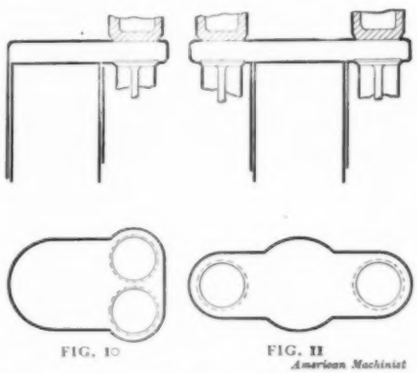

FIG. 10 FIG. 11

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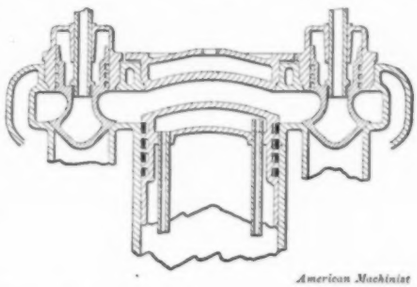
Two Reliable Arrangements of Combustion Chamber and Valves

Eliminate Indifferently Cooled Surfaces

No matter for what class of work the engine is meant, size of bore, compression pressure and piston speed, the greatest possible care should be taken when designing the cylinders, to eliminate all possible indifferently or totally uncooled surfaces; fins in the castings, sharp points or edges such as may occur at the top and edges of the valve, and those edges resulting from boring or otherwise machining the parts of the cylinder, that will be exposed to the combustible gases.

All rough-cast and machined corners within the combustion chamber should be made, not as in Fig. 13, but largely filleted as in Fig. 14. This method insures more equable cooling, more uniform expansion and contraction, and introduces a certain slight degree of flexibility which is often sufficient to prevent cracks from developing, both in the foundry and under working conditions, also slightly less metal is required. If the water-jacket casing follows this curve around the same center, the outside of the cylinder castings will appear much smaller and comelier in perspective.

Flat spots such as are generally found at the tops and bottoms, of valve jackets, piston tops and the lower side of the cylinder heads, if purposely designed flat, should be made appreciably thicker than the cylinder wall minus the re-boring metal. The amount of additional thickness depends upon the length of span, shape of outline, and proximity of such staying features as ribs, passage walls, tie lugs to the jacket casing, etc. It must be remembered that all flat plates under load are particularly liable to enormous bending and cracking stresses even



American Machinist

Fig. 12. A Good Arrangement of Combustion Chamber, Valves and Piston Head

though that load be uniformly distributed. As the plate is arched or dished away from the pressure these stresses rapidly diminish until finally, when the plate becomes cylindrical or spherical, all portions of it are under simple tension. In this shape it requires the least thickness. Were valve pockets designed in cross-sections as in Fig. 15 instead of Fig. 16, not only would the decreased thickness of the metal required be subjected to lower bending stresses due to gas pressure, but the great expansion stresses which are always set up in metal plates which are practically cold on one side and very hot on the other, would be partially compensated for by the added flexibility secured by the curvature of the metal.

A flat non-jacketed piston top may be so ribbed on the under side as to require only a very slight thickness of metal. This thickness, however, should be sufficient to carry the excess heat to the ribs and the ribs should present sufficient surface to the air to prevent the piston top from showing any signs of glowing. Thin, deep, tapering ribs placed fairly close together, and presenting a total effective surface of 3¼ square inches per square inch of that portion of the piston top which is exposed to the hot gases, will be found sufficient to keep the piston top at a reasonable temperature, and will be more than sufficient for strength. A good arrangement of these ribs is shown in Fig. 17.

As has been mentioned, a concave piston top is never good in a vertical engine, at least when the combustion cham-

ber is above the piston, the usual condition in marine-engine practice. For the medium and large size pistons where a dished piston top is very desirable, in all cases make it convex, that is, with a curvature extending into the combustion chamber. If shaped as a spherical segment it will be stronger than a cone-shaped dish and allows greater flexibility under expansion and contraction. A dished cast-iron piston top extending into the pressure end of the cylinder is stronger than the same degree of dish the other way as the metal in the former is subjected principally to compressive stress, while the latter is subjected to tensile stress, and the compressive strength of cast iron is considerable greater than its tensile strength. Also the convex-dished piston top in a vertical engine tends to shed excess oil back to the cylinder wall where it will not interfere with high compression.

Convex Piston Top without Ribs

A convex piston top of proper thickness does not require ribs as strengtheners, being well able to carry its load. For heat-radiating in this case, a more efficient device, which requires less metal than the ribbed type of radiator is shown in Fig. 18, and consists merely of taper pins, cast integral, and placed as closely together as foundry practice will allow, and as long as may be required to obtain the proper amount of cooling surface per square inch of piston top.

The lower or combustion chamber face of the cylinder head may take any desired form, irrespective of the shape of the piston top, but because of the interference of ribs on its upper side with water circulation and removal of sediment and to eliminate excessive thickness of metal, this surface should preferably be dished. As a matter of neatness of design and to insure the lowest possible center of gravity, as affected by the position of the cylinder casting in reference to the piston top, it is better to dish the cylinder head to the same degree and direction as the piston top, as shown in Fig. 12. The removable head shown in the same figure becomes a necessity as the cylinder bore approaches the large sizes, both for convenience and accuracy of boring the cylinder, and for quick inspection of the combustion chamber, without disturbing the piston and connecting rods or valves and valve gear. Also it allows for a more convenient method for removal of the piston when necessary. Even in the medium size and some small cylinders, such a cylinder head is preferable to the removable sort which extends across the entire top of the cylinder and valve pockets, as it is easier to lift, is subjected to less warping and cracking, and causes considerably less trouble with gaskets. In fact it is easily possible in the round type of cylinder head to employ a ground joint near its lower end, as shown in Fig. 12. Such a ground joint will remain tight without resorting to gaskets if the thickness of metal on both sides is uniform, and in direct contact with water. Also the head cannot be rusted onto the cylinder casting, or locked in by deposits of hard carbon in the joint, as would be likely to happen were a gasket placed

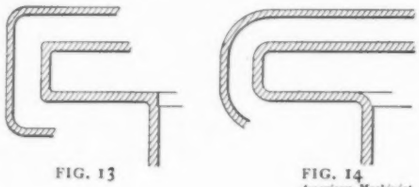
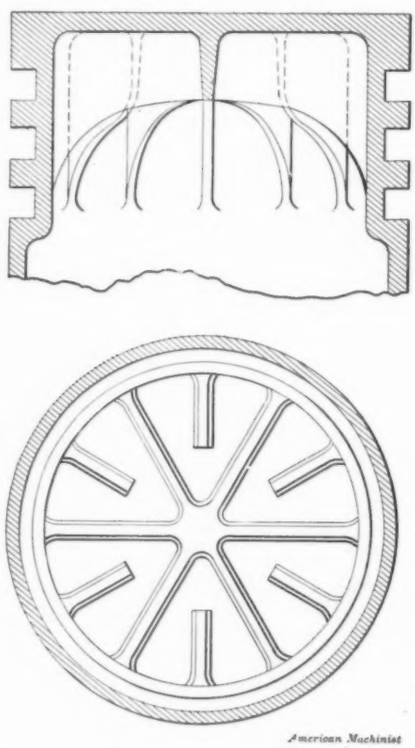


FIG. 13 FIG. 14. *American Machinist*

Improper and Good Filleting

FIG. 15 FIG. 16. *American Machinist*

Good and Poor Valve-pocket Design



American Machinist

Fig. 17. A Good Form of Ribbing for a Piston Top

under the cylinder-head flange. Water connections should be outside where leakage can do no harm, will be seen at once and can be easily remedied.

Exhaust-valve covers, valve cages and ignition plugs, which are put on with turned taper ground joints, as shown in Figs. 8, 10, 11, 12 and 19, will be tight, free from packing troubles and rusting in and will be very long lived if care is taken in designing to prevent unequal thickness of metal between the ground seat and the water jacket.

Valve covers in small and some medium size cylinders cannot justifiably be water-cooled, but should be made extremely heavy, not for strength but to carry off excess heat without warping. In fact, for small engines these covers are more satisfactory if made entirely solid, or very nearly so. In large engines these should be water-jacketed if present at all.

Valve pockets cast separately and bolted to the main cylinder casting are extremely liable to warping, cracking, springing and blowing out of gaskets, when under pressure and expansion stresses, and should be avoided if at all possible, in favor of valve pockets cast integral with the cylinder, even in very large cylinders.

In no case should sudden increases of metal thickness be allowed in a cylinder casting, as considerable sponging, drawing, cracking and other leak-producing troubles are almost sure to result. A generous application of the largest possible fillets, whether in the combustion chamber, water-jacket or on the outside of the casting, will tend greatly to obviate "bad castings" and will improve the appearance.

Cylinder Wall Thickness

The thickness of the cylinder wall in the smaller sizes of engines for any class of work depends more upon the commercial limitations of foundry practice and the conditions of shop practice in machining the castings, than on the actual stresses put upon them when working under gasolene engine conditions. That is, in cylinders up to about 5 inches diameter, a much thinner wall than is commercially obtainable would easily allow of working under heavy explosion pressures, and that at a much higher factor of safety than is usual in other parts of the engine. The wall thickness for such cylinders must, therefore, be modified from the dimensions arrived at through the following formulas.

Allowing a working stress of 3800 pounds per square inch cross-section for a cast-iron cylinder is equal to, for racing machine cylinders 2900 pounds stress for semi-speed and 2000 pounds for heavy-duty cylinders and taking the maximum explosion to be

$$\textit{Maximun explosion pressure absolute} = 51.45 \times \frac{\textit{Total volume actually secured}}{\textit{Actual compression volume}} \times \sqrt[3]{\frac{\textit{Total volume}}{\textit{Compression volume}}}.$$

Then for heavy-duty cylinders—

$$\textit{Cylinder wall thickness} = \frac{\textit{Max. gage press.} \times \textit{diam. of cyl. in inches}}{2 \times 3800}$$

for semi-speed cylinders—

$$\text{Cylinder wall thickness} = \frac{\text{Maximun gage pressure} \times \text{diameter}}{2 \times 2900}$$

and for racing-engine cylinders—

$$\text{Cylinder wall thickness} = \frac{\text{Maximun gage pressure} \times \text{diameter}}{2 \times 2000}.$$

In medium and large size engine cylinders especially an added thickness should be allowed for reboring.

Water Jacket Space

The water-jacket space in very small cylinders may be as narrow as can be produced in the foundry—seldom less than ½ inch. For cylinders of 4-inch bore and over, a water jacket space equal to ⅛ of the diameter of cylinder bore will be found to allow for substantial core work in the foundry, resulting in good castings; and this quantity of water will be abundant for prevention of hot and cold spots in the cylinder, or seething and boiling under heavy loads, generally due to restricted thermo-siphon circulation in the cylinder jacket before being discharged.

The water-jacket casing must be thick enough to withstand the cooling strains to which it is subjected after the casting is poured in the foundry, otherwise it will be found to be very leaky under the water pressure test to which all cylinder castings should be subjected before machining. This test pressure should be about 60 pounds per square inch, not less, as a slightly choked water discharge pipe is often met with in marine engine work, causing the pressure in the cylinders to rise to this point—or higher unless a centrifugal or leaky gear or rotary pump is used for circulation.

Avoid Flat Spots in the Castings

As a general rule cast water-jacket casings seven-tenths as thick as the cylinder wall are required to insure good service.

Flat spots of great size should be as carefully excluded in these casings as in the combustion chamber. Fig. 20 shows how this may be accomplished in a case where two or more cylinders are cast integral. The slight corrugation as shown at *A*, greatly strengthens the jacket wall against internal pressure and though the circumferential length of this wall is slightly longer when corrugated yet the weight of metal taken out at top and bottom more than makes up for this and the casting is consequently a little lighter. Also the quantity of water excluded by a slight corrugation is another saving of weight.

Whether the cylinders are cast in threes, in pairs, or singly, flat spots of appreciable size are liable to develop somewhere in the water-jacket shell, unless special precautions are taken in designing to prevent them. The difference in temperature between the cylinder wall and combustion chamber shell compared with the water-jacket shell, sets up expansion stresses which must be offest.

In medium and large size cylinders,

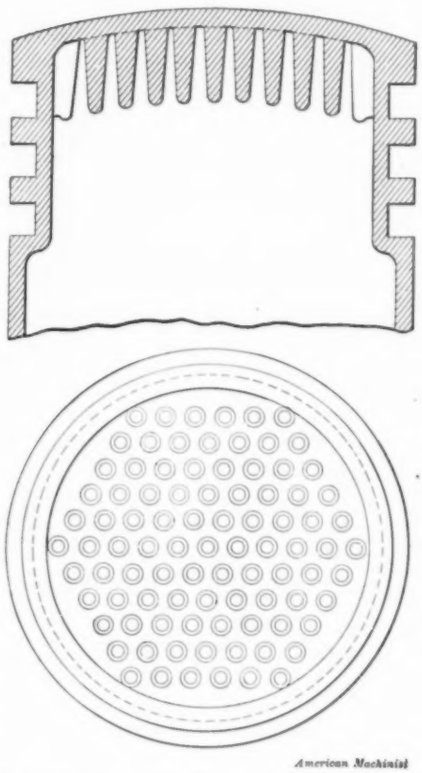


Fig. 18. Tapered Pin Cooling Surface for a Convex Piston Top

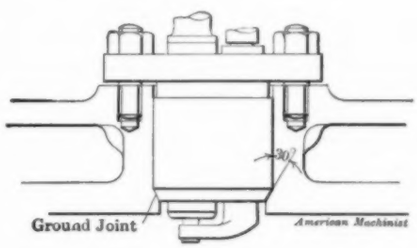


Fig. 19. Design of Ground Joint

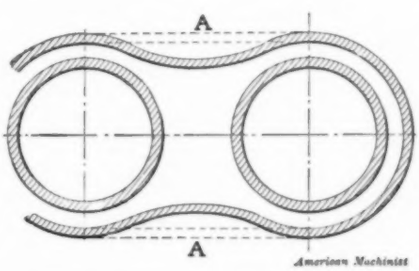


Fig. 20. Designed to Avoid "Flat Spots"

however, the difficulty of securing sufficiently perfect castings makes it inadvisable to cast the cylinders in threes or pairs. The loss to the manufacturer when a small imperfection appears after the cylinders are bored makes the multiple casting more expensive than cylinders cast singly. Also, the cost of replacement to the final purchaser when the cylinders are worn out or broken by accident is derogatory to that make of engine excepting in the small cylinder sizes.

For cylinders up to 5-inch bore the water-jacket core-supports and gas-vent holes may be made large pipe-top holes, but for larger cylinders these should be in the form of large hand holes, covered after machining with bolted-on plates.

The Melville Macalpine Reduction Gear

By George B. Grant

As an old gear man in search of information, I will ask you to explain to me and your other readers the exact difference between the recently invented Melville-Macalpine reducing gear for marine engines and the common "herringbone" spiral gears. I have read several accounts of this new invention that is going to do the business for the present style marine engine, but to date I have not found anything to show that it is not a herringbone gear on a particularly large scale.

Speaking of herringbone gears, there are two new (?) patents, both from Europe, that are seeking someone in this country to adopt them and push them into use. One of these devices has the two parts of the larger pair separated by a space wide enough to take the clearance of the cutter. This is a good idea and as old as I am, and that is old enough, so I fail to see how anyone is going to get a patent on it that will stick. The other device has a continuous tooth and must be cut with an "end mill" cutting tool. This device, also, is old and free to anyone. I would cut the gears that way if I did not know of other and better ways.

[The Melville-Macalpine reduction gear is nothing more than a modification of the common herringbone gear to which Mr. Grant refers. There is absolutely nothing new in the type of gear used—the new feature is its successful application to large units of power. These gears, we believe, are the largest cut herringbone gears so far produced; they operate at a speed heretofore considered prohibitory and transmit a load which, according to the best authorities, would quickly destroy them. Yet these gears operate quietly, show no indication of wear, and are very efficient. This is largely due to the use of a floating frame which carries the pinion. The frame allows the gears to adjust themselves to any inaccuracies in the cutting of the teeth; the gears are therefore practically independent of commercial errors which are impossible to eliminate. —Ed.]

An Inside View of the Apprenticeship Question *By an Apprentice*

In view of the somewhat extended discussion of the apprenticeship question at the present time, it seems that a few words from the boy's point of view may not be without interest. I am an apprentice in one of the largest manufacturing plants in the East, where conditions may be taken as fairly typical. While this shop does not maintain any regular apprenticeship course, there is a sort of unwritten understanding that a boy will be given a chance to move around sufficiently to learn the different operations and processes. This is done entirely within the tool room, which employs from 150 to 200 men.

When a boy starts in he is usually set milling cutters, reamers, etc., learning to set up the job on the miller, and being, with the exception of an occasional speeding-up, left largely to his own devices. Right here the first fault of the system develops, a fault which seems to be pretty general among similar shops. A boy after the first feeling of abject greenness has worn off, is rather inclined to go ahead on his own hook, and hates to keep asking questions and bothering the gang boss about details, which to the latter may seem so obvious that "any fool could see that." This results in many spoiled jobs and consequent hard feelings.

After a boy has milled cutters for six or eight months, provided that he has not put too many jobs "on the bum," also provided that he kicks sufficiently and has not had any fights with his boss, he is moved to a lathe, where he turns up simple cutters, end mills, etc., until he is heartily sick of the job. Here also the lack of any real instruction is felt. The gang-boss may run off a few jobs for him, during which he is expected to grasp all the principles of lathe operation, after which any requests for information will be met by an impatient "How many times do you want me to show you that?" If the boy goes to any of the toolmakers for help, they will probably show him one of the "just as good" ways of doing the job, the use of which will most likely secure for the unfortunate neophyte a "call down" from the boss.

At the end of nine months or so of this work, the boy may get himself put on a shaper, where the process of learning by experience is repeated. Occasionally he will get a drill-press job, or a simple job on some other machine where a large number of duplicate parts are needed.

The Second Year

At some time during his second year the boy may be transferred to some other gang, where he does simple jobs of various kinds, and is expected to keep his eyes open. Supposing he is put to running a miller in the jig and fixture gang, after sticking to this job for some months he may have a rather complicated grinding or milling fixture sprung on him, to lay out, machine, and assemble entire. If he has luck and makes enough of a nuisance of himself, he may possibly get this cut all right, but the chances are that it will come sailing back from the inspector, conveyed by a ruffled and contumelious gang boss. In this event he goes back to the miller, and any request for a change of work for some months to come will be met by a reference to this failure.

If he should make good on the job, he will be given pretty good work, though no increase of pay, while if he does not make good he will have small chance of learning for some time to come.

Effect of This Treatment

Enough has been said above to illustrate the system, or rather lack of system, employed in "teaching" the boys who are working 10 hours a day for a sum not large enough to pay the bare cost of living. They naturally work for this small sum in the hope of learning enough to pay for their trouble, but it is very questionable if they do this, and what they do learn is on a rather insecure foundation, as they find out when they move to some other shop.

It is obvious that under this system a boy almost certainly, unless bound by those ties which the economists tell us account for the "immobility of labor," will either drift away into some occupation which offers more attractions, or if the ambition-killing monotony is not strong enough to destroy his natural mechanical taste, he will seek employment in some other shop, on the principle that it is much easier to get higher pay at the start than to get a raise once having started. A boy remaining in the shop knows that be his work good, bad or indifferent, at the end of a year he will be raised from five to six dollars a week, and at the end of the second year to seven dollars, and so on. Probably no one ever stayed a sufficient length of time to find out how long it would take to get full toolmaker's pay.

Discontent among Machinists

Another cause of the failure of the apprentice to stick is the general feeling of discontent that pervades machinists as a class. I have yet to hear a single man express himself as satisfied with his trade. When a man was asked why he stuck to his trade, if he disliked it so much, the answer generally was: "What can I do? It's the only way I know of earning a living. But if I were a young fellow like you, just starting out, I would do this, that and the other; in fact, anything but learn toolmaking." This kind of talk is by no means confined to the men, but is also heard from the small bosses. In fact, every boss I have worked for has in some expansive moment reasoned with me against my selection of a trade. And can we wonder at this pessimistic attitude when we look at some of the men we see in the tool room, crack mechanics, men of brains and a self-acquired education which many college graduates might well envy, who are earning $21 a week, with no chance of advancing beyond this, except an indefinite daily drudgery until they become too old to be useful? The common and laudable ambition among the married men is to make their sons something better than the father, which, while very praiseworthy, is not conducive to an increased supply of apprentices.

Mr. Colvin, in his interesting article in a recent issue, refers to the value of men who say "we" and talk about "our shop." Such a man is indeed something of a *rara avis*, as it is customary to call the shop "this dump," and find fault with everything those in authority do. The so called model shops by no means escape this criticism.

The Trade School Graduate

The boy is by no means encouraged to take advantage of the trade schools, as the graduates of these schools seem to be held in small esteem by the practical men. One boss said: "Oh, yes, they can turn out pretty-looking jobs, but as to getting anything down to a thousandth they arn't worth a damn." The boys' point of view, as expressed by one of them, was: "Well, I went to evening school for two years, but now I'm not getting any more than anybody else."

These are a few of the discouraging things that confront the would-be toolmaker. When we consider that the toolmaker is the aristocrat of mechanics, that his condition and pay are the best of his class, it is no wonder that for the lower-paid jobs there is no keen competition. On the other hand, if a boy were given really interesting and instructive work, he would be willing to put up with the low pay and other discouraging features, since he would know he was really learning something. The cost to the shop would not be prohibitive, since with a little careful supervision a low-priced boy could do many jobs now done by a high-priced man. Hence it appears that a little more careful planning and directing of the boy's first efforts in his chosen work would obviate a difficulty which threatens to assume serious proportions.

Some Curious Effects of Hydraulic Pressure *By F. H. Stillman* *

When water under an unbalanced pressure of 6000 pounds per square inch escapes through an opening, its speed is over 56,000 feet per minute, or 640 miles per hour. Even with only 1000 pounds unbalanced pressure, the speed is over 23,000 feet per minute or 260 miles per hour.

It may readily be supposed that to deal with such high pressures and incredible speeds, the design of hydraulic machinery includes many special features not met with in any other branch of manufacture. Think what it must mean to open a controlling valve with water pressure of 6000 pounds per square inch behind it. At the first movement of the valve, this pressure would be practically unbalanced and the instantaneous rush of water through the opening can easily be imagined to have a destructive effect upon the surrounding metal.

As a matter of fact, this is a serious item in this class of material and the accompanying halftones will prove interesting evidences of the remarkable scoring effect of water at these tremendous speeds. Figs. 1 and 2 show two inner valves and stems of double hydraulic valves for 1000 pounds pressure. One of these small valves is located within the main valve and the first motion of the controlling handle opens the small valve to take care of the first rush of the water, to equalize the pressure. After equalization, the further movement of the controlling handle opens the main valve itself to allow free flow.

With this construction, the heavy wear and tear due to the enormous water speeds developed, come upon the small equalizing valve and this, being easily replaced when worn, adds materially to the life of the main valve. The valves themselves are made somewhat softer than the seats and bodies, as they are the more easily replaced. This equalizing valve also makes it easier to open the main valve, of larger unbalanced area.

Around the necks of the valves shown in Figs. 1 and 2 will be seen the deep scorings of the water and the very sharp edges left on the metal are truly remarkable. Fig. 1 is really the most interesting of all, because in this case the scorings are so deep that they actually cut entirely through the valve stem in two directions. On both of these valve stems, higher up, are plainly visible flat places worn by the "rebound" of the water after passing the valve and probably being deflected by the inner surface of the valve body.

Fig. 3 is an ordinary small-sized control valve for 6000 pounds pressure per square inch and the deep, narrow, very sharp grooves in it could be cut with nothing else but an engraver's tool. In fact in this and in Fig. 1, the depth, narrowness and sharpness of the cuts would be difficult to reproduce with tools because the grooves are deeply undercut in complicated curves, impossible to show in the halftone.

Fig. 4 shows a hydraulic safety valve, also for 6000 pounds pressure, and the scorings in this piece suggest nothing so much as the action of a small, very sharp-edged file. The "rebound" is also visible on this piece.

Fig. 5 shows two views of a steel valve bushing with a sharp and ragged cut in its edge. The peculiar thing about this piece is that the cut, which was made by water at 6000 pounds pressure, has every appearance of having been *burned* out and the steel on each side is blued for a distance of an eighth of an inch. The reader may scoff and the statement is not positively made, but would it not seem possible for material cutting through steel at a speed of 56,000 feet per minute to develop some heat? This may seem more plausible when it is stated that these cuts are made in but a few moments of time. The first start is from some scratch upon the valve seat; the water shoots through, literally tearing the metal away and enlarging the hole with the rapidity of a file.

Of course, the heat developed in the water would be inappreciable, because, traveling at such speed, it is the successive particles of water which do the cutting and the heat of any one particle would be dissipated in the large body of

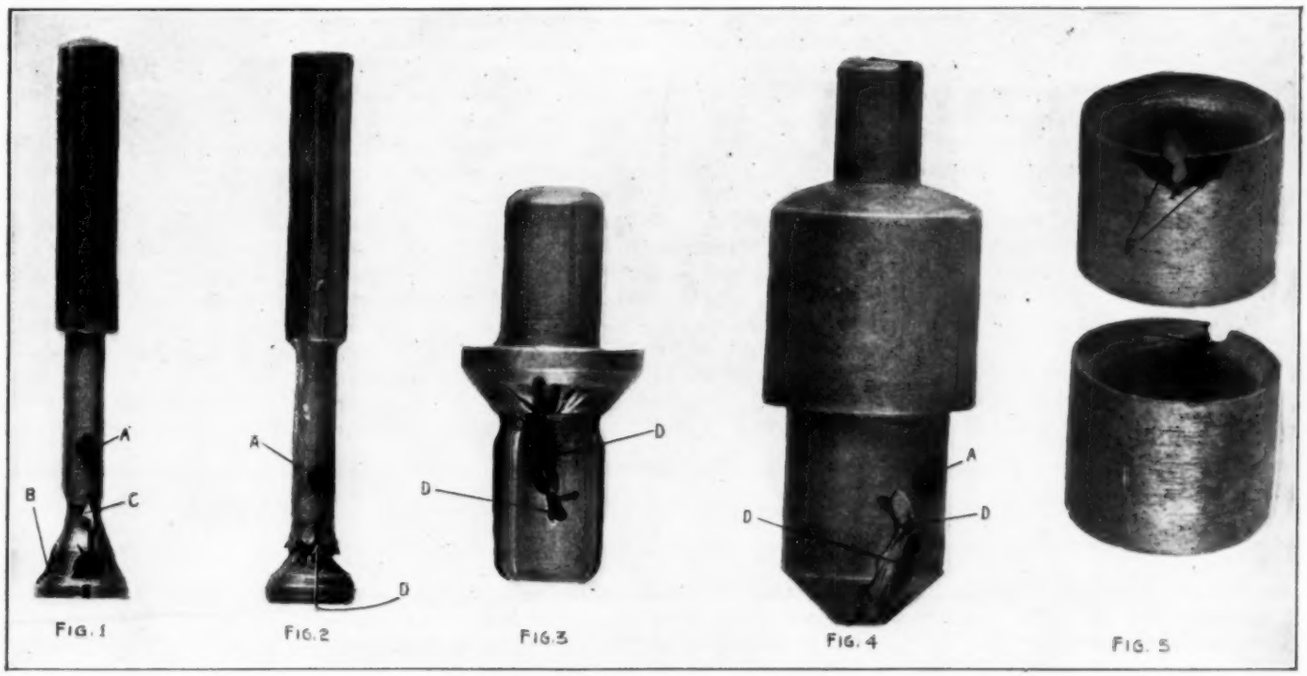


FIG. 1 FIG. 2 FIG. 3 FIG. 4 FIG. 5

HYDRAULIC PRESSURE VALVES CUT BY JET OF WATER. FULL SIZE.

A, rebound. *B* and *C*, cavities cut through and connecting with each other. *D*, grooves undercut 3/16 inch. *E*, hole cut through. *F*, portions turned blue as if from heat.

*President Watson-Stillman Company, New York City.

water into which it flowed on the other side. On the contrary, the steel valve bushing has to remain stationary and receive the terrific cutting action of all the water particles passing through. The cutting is done with such rapidity that it is possible to imagine that there would be heat enough generated and retained in the metal to blue the surface, as in this case. It would be impossible to form steam at this pressure at less than 800 or more degrees Fahrenheit temperature, which would be hot enough to account for the effect produced. In fact bluing would take place at about 580 degrees and the first red heat at about 1000 degrees Fahrenheit.

Now, how is it possible for clean water, which certainly seems nonabrasive, to cut metal in this way? It is undoubtedly true that the cutting is done by solid impurities, probably of infinitesimal size, which are always present, even in "clean" water. Suppose, for instance, there was one small particle of undissolved mineral matter in the water for every foot of pipe. Even at this "thinly settled" state, 56,000 particles would pass through the hole during one minute. As there are doubtless many more mineral particles than this, present in most cases, the filing action upon the metal is not hard to explain. In fact in the case of Figs. 1 and 2, which came from an iron and steel handling yard, small particles of these metals probably did the cutting.

But when all reasonable precaution is taken to use clean water, where does the dirt come from? There is always some dirt to get into the supply tank from the atmosphere and the stretch of the pipe walls under the heavy hydraulic pressure, must cause little particles of scale and metal to break loose and be carried on with the stream.

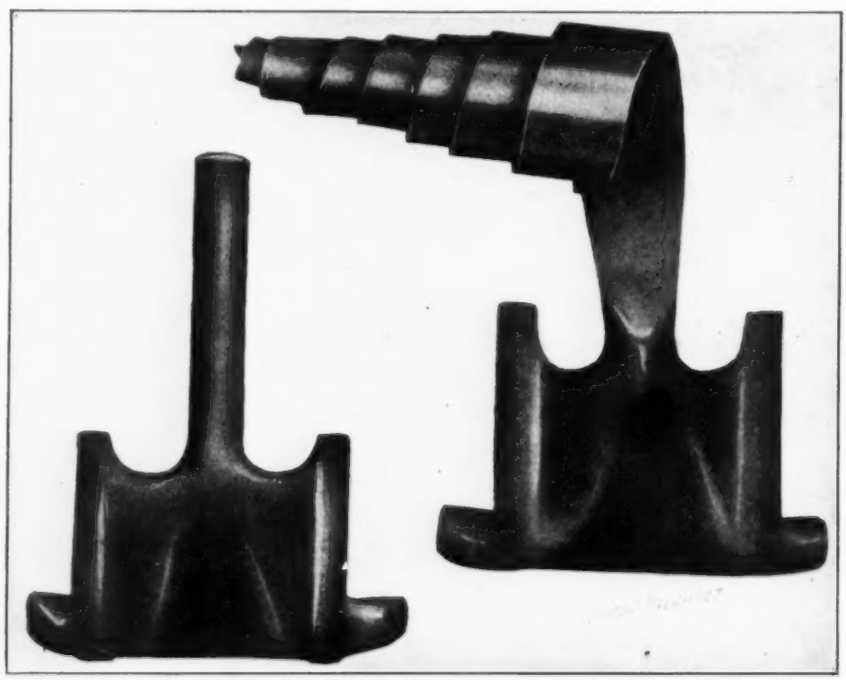
When the high speeds and their resultant serious cutting action upon the valves are considered, it may well be understood that attempts at throttle control for slow movements of hydraulic machinery would soon render the valves useless. To overcome this, and yet secure a slow movement, such as would be required to apply a gradually increasing pressure to some yielding material in a hydraulic press, a device known as a "choker" is used. This choker is nothing more nor less than a piece of amethyst with a needle hole through it, which is firmly fixed in the pipe line at the desired location and through which all the water must flow to the particular piece of apparatus under control. The needle hole allows only a small stream of water to flow through, holding back the main body, thus moving the ram slowly, uniformly and yet relentlessly, for, as soon as the ram encounters resistance, it slows up slightly, allowing the pressure to build up behind it as the water continues to flow through, until when the ram stops, the full hydraulic pressure of the system is equalized on both sides of the choker and so transmitted through the needle hole.

If the whole piping system were made small to secure this result, the high speeds due to the unbalanced pressure created would cut the pipes to pieces. However, by confining the choking action to the amethyst, its extreme hardness resists the powerful abrasive effect of the water rushing through it. In this way the controlling valves are relieved of the throttling work.

One other curious effect shows itself in a carbonizing action on cup leathers used for packing. This takes place under the heavy pressures when there is even the least bit of heat present and the appearance of the leather is as if it had been charred or partly burned. The interior of the leather takes on a hard, brittle character with a shiny coal-black appearance, while the little altered outside surface tears away from the hard inside substance as if it were separate.

Interesting Sample of Malleable Steel Castings

Some brands of the steel castings made by the Flexilis Works, Ltd., of Berlin, Germany, and represented by Henry Hess, Philadelphia, Penn., are very malleable. The accompanying illustration shows one of these castings as it left the mold and another casting from the same lot that had the round end hammered out into a thin ribbon. The bar-like end before it was hammered out was about ½ inch in diameter and 5 inches long, and this hammered out into a ribbon about 1 inch wide and 1/16 inch thick.



SOFT STEEL CASTING BEFORE AND AFTER HAMMERING

As will be seen, the hammered metal showed no sign of a flaw, did not tear on the edges, and showed a very smooth close grain. This would indicate that the metal was homogeneous and free from any signs of blowholes. The castings were made from a soft steel which very closely approaches wrought iron in its composition.

In a paper presented before the American Society of Mechanical Engineers dealing with graphite as a lubricant, and pointing out the advantages of using the deflocculated brand, it is stated that of all the solid bodies available for lubrication, graphite possesses the desirable unctuous quality and great durability, and when in its purest condition and in a state of extreme subdivision it is a most useful lubricant. The superiority of an ideal solid lubricant, that is, one that should embody an equivalent of the desirable qualities of the liquid products with a greatly superior wearing quality and a low coefficient of friction and at the same time a substance readily convertible into a form that can be conveniently applied to the various forms of journals and bearings, has always been recognized.

Theory of Impulse Pumping and Construction of Pumps

The Common Theory Possibly True Only in Case of Low Heads

By John Richards

It is more than a century since impulsive pumping was introduced by Montgolfier among many other improvements or discoveries in hydraulics that have rendered his period remarkable.

Other discoveries in hydraulics, if we except centrifugal pumping, have come down to us in scientific dress, like the water turbine in its various forms of Jonval, Fourneyron, Girard and Poncelet wheels; their subsequent modifications being only a matter of adaptation to head or pressure; but in recent times they have been much simplified and cheapened in form by the American inward discharge wheels, or as the French call them, "centripetal" turbines, that even exceed their French predecessors in dynamic efficiency at half the original cost of construction.

But while other kinds of water-motor

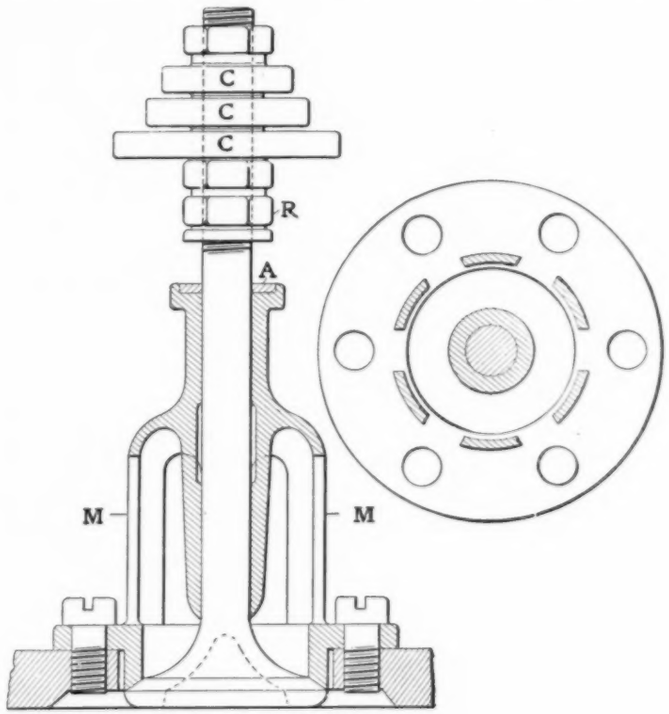


FIG. 1. Plain Uncushioned Clack Valve Guided from above.

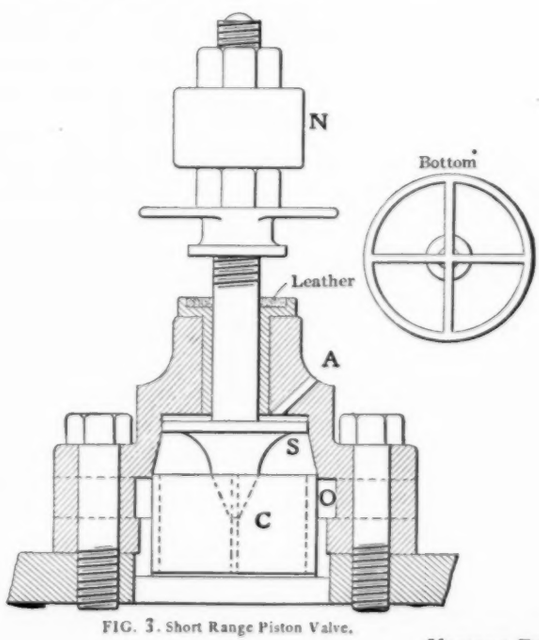


FIG. 3. Short Range Piston Valve.

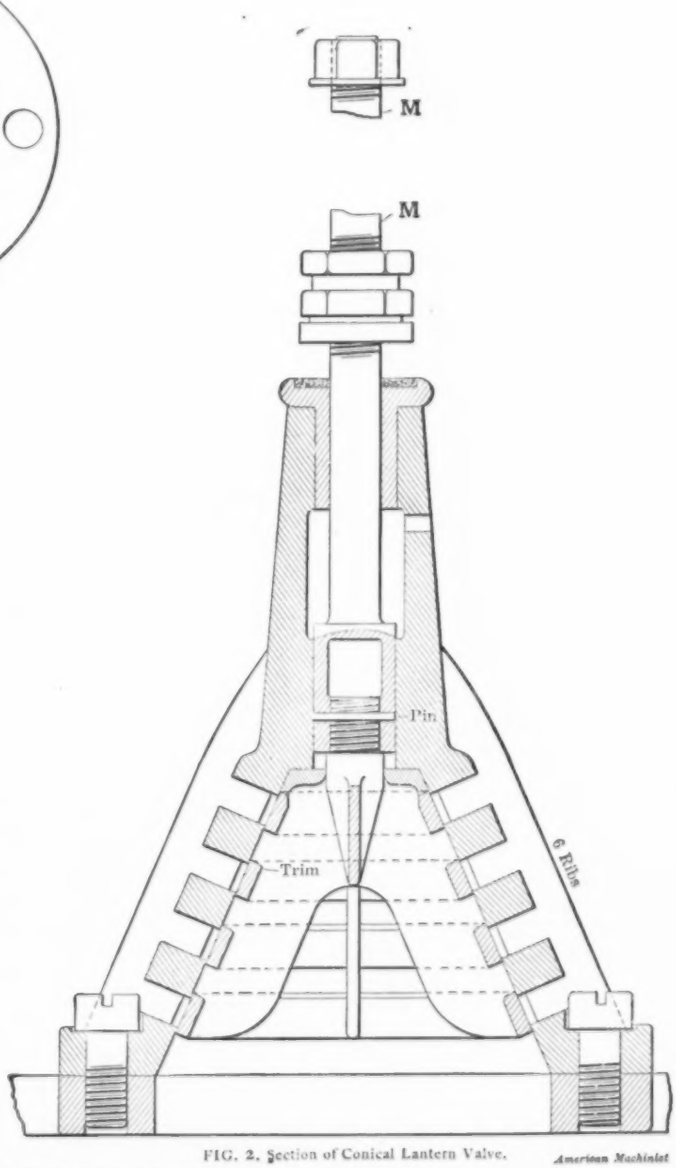


FIG. 2. Section of Conical Lantern Valve.

American Machinist

VARIOUS FORMS OF IMPULSE PUMP VALVES

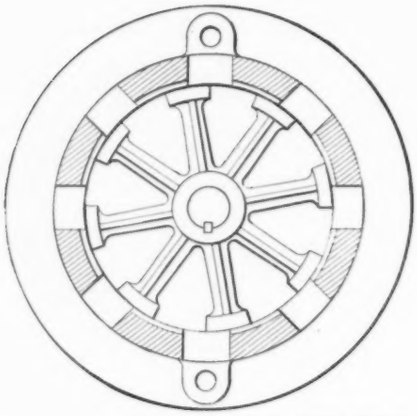


FIG. 4. A ROTARY OR OSCILLATING VALVE

machines have progressed, what may be called the "impulsive" class has in a manner remained dormant. It is true "hydraulic rams" have remained as a common and well-known means of pumping water, but it is not to be doubted that if there had been a corresponding effort to improve and adapt them to conditions which they naturally fulfill, the result would be different. This is in part due to the irrelevant and untranslatable English name of "ram," which has led to a popular opinion that a "ram" must *sui generis* be a method of water power unlike all others and this idea has been fostered by some other causes, such as the automatic action of waste valves, especially when we consider that there is not even now any scientific explanation of the apparently anomalous action of such automatic waste valves.

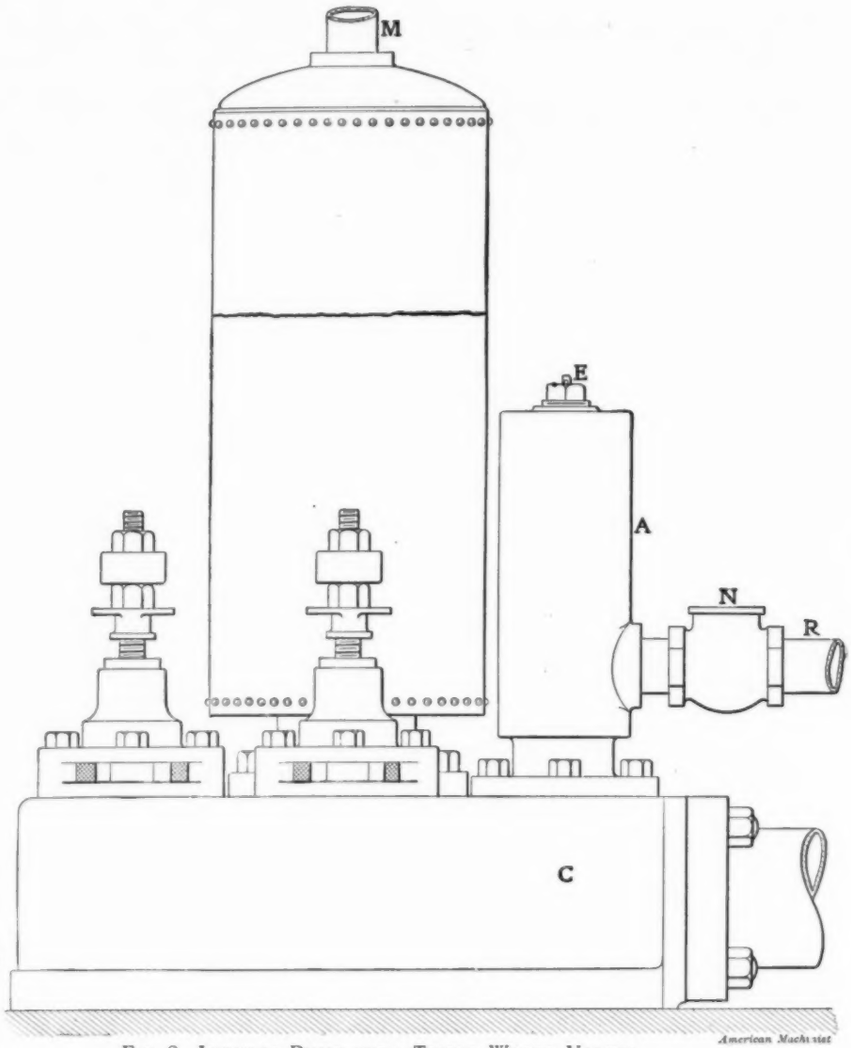


FIG. 6. IMPULSE PUMP WITH TRIPLE WASTE VALVES

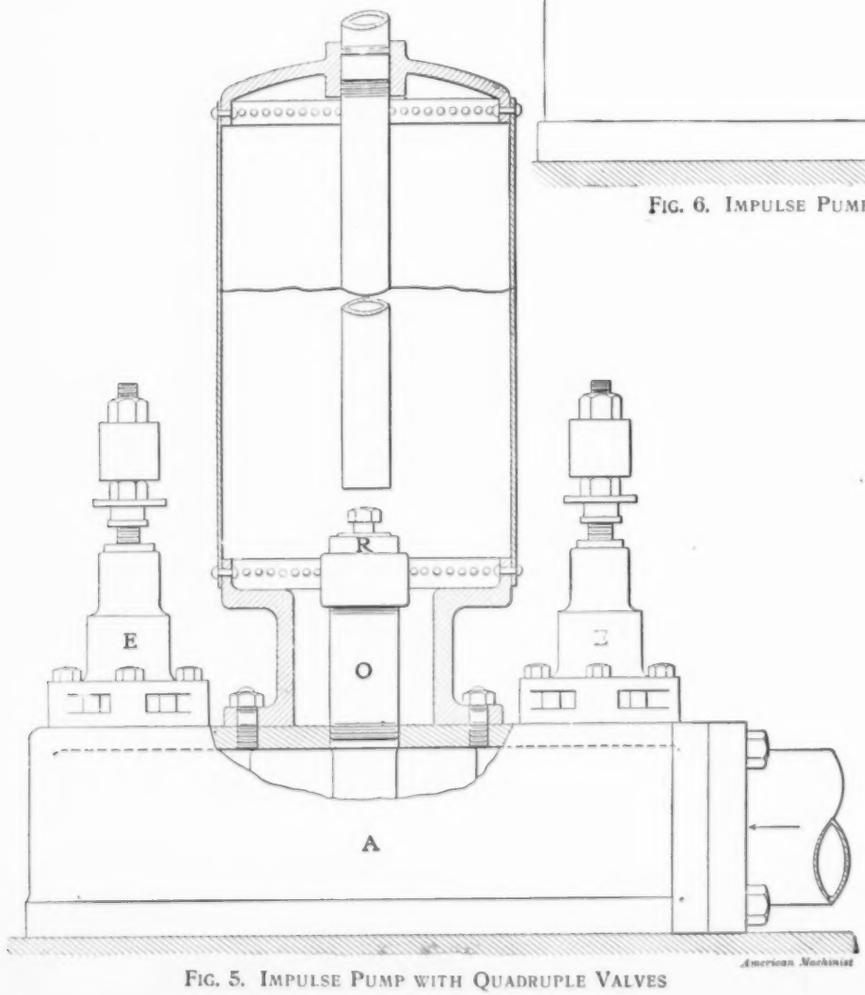


FIG. 5. IMPULSE PUMP WITH QUADRUPLE VALVES

In theory, the impact of moving water in pipes or its kinetic energy is equal to its potential energy in other forms of application, and while there must be some loss due to intermittent effort—as will hereafter be explained—a careful authority at hand sets down the measure of effect to be obtained by impulsive machines with automatic valves at 60 to 70 pc. cent. compared with water wheels and pumps combined at the same. This is probably correct for moderate heads and average practice. There are, however, many countervailing conditions to be taken into account that will be named further on.

Another reason that has hindered the use of impulse machines, especially on the Pacific coast, has been a dread of "water ram" in pipes.

In the high-pressure water-wheel prac-

tice of the Coast, a great, if not the greatest, impediment met with has resulted from water ram, as indicated in various ways, including diagrams of pressure in the uptake pipes in the Comstock mines of Nevada, which are erratic and amazing, but is especially notable in the mountain conducting pipes for tangential water wheels where the greatest difficulties arise from water surge due to changes in velocity. This impediment is so formidable that engineers have almost ceased to control water wheels by throttling, which causes a change of velocity.

In impulsive-acting machinery, when valves have been operated positively and by extraneous power, and the force of the water cushioned, as by Sommelier at the Swiss tunnels in his air-compressing machines, also by Mr. Pearsall in England, who made a number of large impulsive machines some years ago, the indicator curves traced showed not only a good efficiency, but a smooth, easy working, at about 70 per cent. of the theoretical value of the water energy in the later case.

Of course, there is little control over pressure in the case of noncushioned automatic valves, and little is attempted; the "toe" of the diagram is lost in pumping water, as well as in any other known method of utilizing the energy of an intermittent force. This was shown by my recent article on "Wave Motors," but the result is good, practical and "commercial," and is the best in a great many cases. It deserves at least consideration such as is bestowed upon other classes of water-raising machines.

The "toe of the diagram" which I have mentioned, and is no doubt the main cause of "regurgitation," occurs in, or after the closing of automatic waste valves, and when the pressure falls below the static head of delivery. Here is a subject for mathematical investigation capable of complete analysis by someone with the required skill and so disposed. That it would result in much practical gain may be doubted, but it is in the order of modern procedure and would be a "comfort."

Common Theory of Impulse Pumping

In the school books and in authority of more pretense, we find the theory of impulse machines set forth in substance as follows: "The waste valves sink and open against the static driving head by their 'weight' and then close by the wash of the water when it starts through the supply pipe." This is quite simple, but is not true except in the case of very low heads, and perhaps in no case. The valves open by what someone has happily termed "regurgitation." This means a forcible reaction opening of the valves for reasons not well understood.

The rebound or reaction and elasticity of the water from contained air, the elasticity of the supply pipe and water chambers and the closing of the check valves have been suggested as causes, but they do not seem sufficient to produce an action such as occurs. The weight of the valves does not seem to matter much, except to modify the periods of impulse, and this does not materially affect the working result.

Another thing to be remarked is the uniform action of valves of all kinds, with, however, a more perfect working of valves of small size. The practical history of impulse machines is a record of the better performance of small valves. The author, about 12 years ago, constructed for experiment escape valves of various kinds, including the plain clack valves not cushioned; piston valves discharging upward, downward and laterally; lantern valves, both sliding and rotary, and found the phenomena of "regurgitation" common to them all and especially of the rotary or oscillating lantern type 12 inches diameter, which closed forcibly without weights, springs or other apparent cause. Springs were provided, but not used. Also a little later I designed and patented a machine with multiple waste valves and made for service machines to determine the uniform action of the multiple waste valves.

Economical Phase of Impulse Pumping

Turning briefly to the economical phase of impulse pumping, there are a number of features in its favor. In many cases it is by all means preferable to converting water power by a wheel and pump which gives no more, or even less efficiency. The machinery costs not half as much, needs no attendance (not even lubrication) and does not wear out. Its impediments are that each case requires special treatment, has a narrow range of capacity or duty for each machine, and above all is not well understood.

These impediments can no doubt be

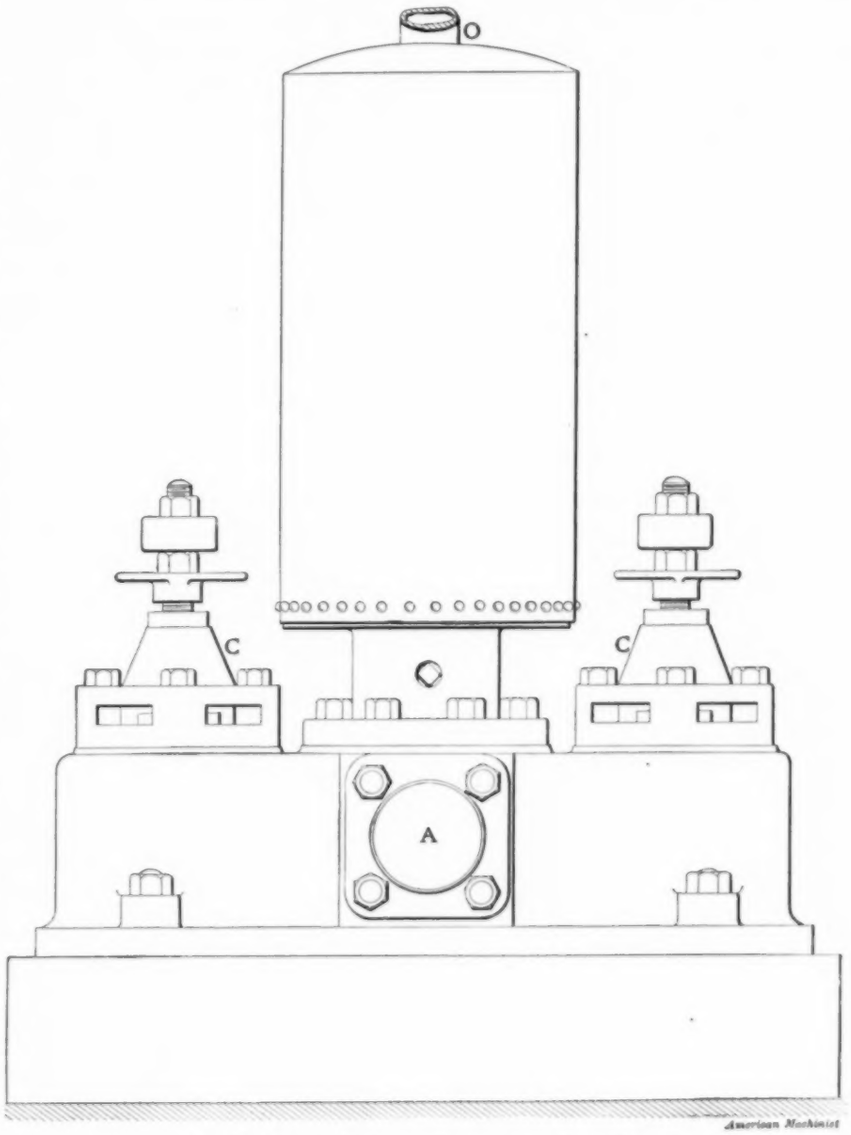


Fig. 7. Small Impulse Pump with Two Valves

overcome. The range of duty can, or ought to be overcome, to meet a varying want or supply and thus evade in a great degree special adaptation in each case —that is, operate from 10 to 100 or from 100 to 400 gallons per minute in pumping air, compressing or other work permitting intermittent effort.

Constructive Features—Waste Valves

Turning next to various constructive features and first to waste valves, these are commonly made of the clack type, sometimes with an elastic facing or seat that gives some resilience, but not a complete cushion. Such an arrangement must involve wearing or perishable parts and will not be included in the plans shown.

Fig. 1 shows in section a plain uncushioned clack valve with guidance from the top, but valves of the same type can also be guided at the bottom. *A* is a leather washer to cushion the drop and *C C C* are weights that can be changed as determined by the working equipments. Adjustments of the range is by the screw-nuts above. This is a very simple form of valve, with perhaps the objection of not being cushioned and not having bottom guidance.

Fig. 2 is a section through a conical lantern valve, which gives a vent of large area for the space occupied, has a short movement and good guidance by reason of its conical seat. A valve of this type 5½ inches in diameter at the bottom, will give a vent of 19 inches area. Weight to suit can be added at *M*. The extreme range is only half an inch and the valve is no doubt as large as any need be made for pipes up to 12 inches in diameter. Six such valves will vent for a drive pipe of 12 to 14 inches diameter, or a delivery pipe of five inches diameter.

Fig. 3 is a piston valve with a short range, free lateral vent, and can be instantly changed from a clack to a cushioned valve by opening or closing an air vent at *A*. The main valve *C* is shown closed and has the usual provision for weights at *N*. The discharge is lateral at *O* and the valve lifts by reaction under the collar or hood *B*. The diagram Fig. 4 shows the construction of a rotary or oscillating valve. A complete drawing of a machine with valves of this type is shown in a paper read before the Society of Mechanical Engineers, London, about 10 years ago, and of which no copy is at hand for reference.

Such valves have no doubt many good features, especially for low heads and large volumes, but require extraneous means to open them; also may be liable to obstruction. A 12-in. valve of this kind with ports two widths in hight will vent for a driving pipe 10 inches in diameter.

Construction Features of a Few Pumps

Fig. 5 shows, partially in section, an impulse pump with a 4-inch supply pipe and quadruple waste valves, of which only two are seen in the drawing, one being behind the air vessel. The base or main channel *A* is circular in form and suitable for multiple valves, also is a logical design because of complete strength in its horizontal section, while the top and bottom plates are combined by hollow struts *C*, which are cored for anchor bolts, if these are required.

The attempt to continue a pipe section body through a main chamber conserves no purpose that need be regarded, except in operating at low heads when the flow is large, or with a nearly constant velocity. The present construction gives the machine a symmetrical shape, is better than the English rectangular form that requires very thick walls and heavy castings—a matter not much considered there, however, where such castings cost much less than here. There is also an opinion that the weight is desirable on the "anvil principle." The latter remark comes from a noted maker in England and does not admit of intelligent argument. The waste valves *E E* are in this case of the piston type and the foot

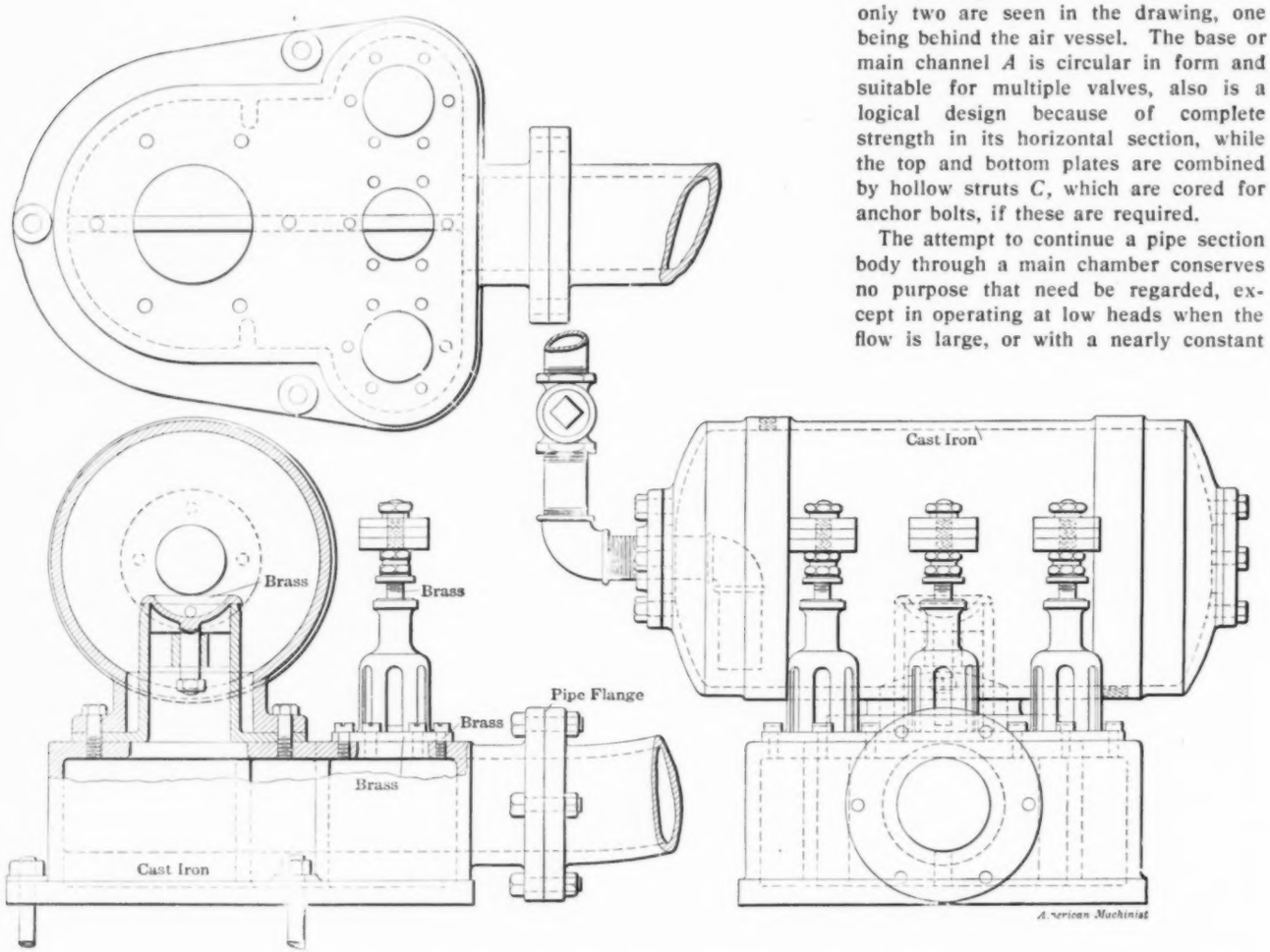


Fig. 8. An Impulse Pump with Horizontal Air Chamber

valve is of less than normal size or for a tolerably high head. The air vessel is quickly removed by disconnecting at the top and the foot or check valve *R* is also removable by means of the nipple *O* or may be set in the top of the main uptake pipe.

Fig. 6 is a smaller machine of the same type as Fig. 5, with triple waste valves, the place of one waste valve being occupied by a receiver *A* employed in pumping water separate from that used in driving the machine. This receiver contains a body of water that falls into the chamber *C* at the time of back action or "regurgitation," an air valve at *E* permitting this. The supply pipe by this arrangement can be nearly as small as the delivery one *M*. A check valve at *N* prevents back flow in the pipe and a deflector in the main chamber prevents the water from mingling with the main supply.

Fig. 7 is a dual-valve machine of small size, corresponding in general to Fig. 5 and Fig. 6, but for higher pressure. At *A* is the supply pipe, *O* the discharge. The valves *C C* are of the piston type, differing somewhat from Fig. 3.

Fig. 8 is of a machine made in 1901 that gave good results.

The valves are the same as in Fig. 1, made of hard metal (copper 6, tin 1). The particulars of its operation were lost in the San Francisco fire of 1906. The air vessel was disposed horizontally to avoid the inertia to be overcome in the sudden opening of the foot or check valve, due to high pressure.

This latter is a feature not to be disregarded in the construction of impulse pumps, especially for high heads. The area of these valves should be computed from their outside contact, or their extreme diameter, as the force to raise and open them is considerably in excess of the static delivery pressure. They open suddenly by a blow, as it were, and the depth of the superincumbent water is a factor of resistance.

The principal loss in impulsive pumping is that part of the impulsive effort that remains after the check valve closes, or expressed in other terms, it is the energy of impulse at a lower pressure than that of the delivery head, and it is easy to see that such loss increases with higher heads and pressures. Similar loss may exist in centrifugal pumping, when the rotative velocity falls below the falling velocity for an equal head.

It is notable that in the printed circulars and catalogs one will find no tables for efficiency, except in the case of centrifugal or rotative pump. There is none given for the numerous forms of common displacement pumps, the greater share of which operate much below the efficiency of impulse machines.

Testing Pressures With Lead Cylinders—Revised Table

Plug No.	Falling Weight, Pounds.	Drop in Inches.	Inch-Pounds of Energy.	Plug Dimensions in Inches.				Striking Velocity, Feet per Second.	
				Long.	Upset to.	Upset.	Average Upset.		
13	20	240	4,800	1.489	0.979	0.51		35.9	
14	20	120	2,400	1.494	1.165	0.329		25.4	
15	20	240	4,800	1.492	0.983	0.509		35.9	
16	20	360	7,200	1.492	0.848	0.644		43.9	
17	50	120	6,000	1.492	0.911	0.581		25.4	
18	50	240	12,000	1.492	0.656	0.836		35.9	
19	50	360	18,000	1.492	0.505	0.987		43.9	
20	100	360	36,000	1.491	0.307	1.184		43.9	
21	100	240	24,000	1.491	0.409	1.082		35.9	
22	100	120	12,000	1.489	0.652	0.837		25.4	
23	150	360	54,000	1.491	0.194	1.297		43.9	
24	150	240	36,000	1.495	0.290	1.205		35.9	
25	200	120	24,000	1.492	0.401	1.091		25.4	
26	200	240	48,000	1.493	0.219	1.274		35.9	
27	200	120	24,000	1.489	0.405	1.084		25.4	
28	150	120	18,000	1.492	0.501	0.991		25.4	
29	150	240	36,000	1.502	0.275	1.227		35.9	
30	150	240	36,000	1.503	0.275	1.228		35.9	
31 32	150	240	36,000	1.498 1.498	0.502 0.507	0.996 0.991	0.993	35.9	Weight of Anvil—8660 Pounds.
33 34 35	150	240	36,000	1.5 1.498 1.495	0.670 0.681 0.677	0.830 0.817 0.818	0.822	35.9	
36 37 38 39	150	240	36,000	1.5 1.5 1.498 1.5	0.769 0.778 0.778 0.771	0.731 0.722 0.720 0.729	0.725	35.9	
40	150	240	36,000	1.498	0.279	1.219		35.9	
41 42 43 44	200	240	48,000	1.497 1.502 1.502 1.502	0.663 0.660 0.660 0.650	0.834 0.842 0.842 0.852	0.842	35.9	
45 46 47 48	200	356.5	71,300	1.5 1.501 1.5 1.502	0.515 0.525 0.525 0.515	0.985 0.976 0.975 0.987	0.981	43.7	

Note.—Where division lines include two or more plug numbers, the weight was dropped upon as many plugs at one time as there indicated.

RECORD OF COMPRESSION TESTS ON 1½x1½-INCH LEAD PLUGS.

On page 436 we published a table showing the results of drop-compression tests on lead plugs, this article being written by W. T. Sears, mechanical engineer, of the Engineering Bureau of the Niles-Bement-Pond Company.

Our attention has been called to the fact that the form in which this table was printed is misleading, in the latter half. It should have been shown that in tests Nos. 31 and 32, the 150-pound weight fell upon two plugs at one time. In tests Nos. 33, 34 and 35 it fell upon three plugs; in Nos. 36, 37, 38 and 39 upon four plugs. In tests Nos. 41, 42, 43 and 44, the 200-pound weight fell upon four plugs at one time which was also the case in tests Nos. 45, 46, 47 and 48.

Under the column headed "Av. Upset," the sets of the different plugs in any one test are given as an average for those particular plugs. Owing to the possibility of misunderstanding this situation, we herewith reprint this table of test results.

Cleaning and Polishing Brass

A recipe for cleaning and polishing brass reported to give good results is as follows: One pint sperm oil; ½ ounce camphor gum, pulverized; ½ ounce oxalic acid, pulverized; ½ ounce arsenic; 2 ounces fine emery flour; tripoli to thicken to a paste. Place the sperm oil in a can or bucket, set it over the fire, bring the oil to a slow boil; place the camphor gum and oxalic acid in the hot oil, stir until entirely dissolved, when add tripoli, emery and arsenic; use tripoli enough to make a thick paste. This will always stay as a paste and not get hard.

A Novel Fine-Measuring Machine

By A. Gradenwitz

The engravings illustrate the features of construction and some applications of the "minimeter," a patented fine-measuring apparatus, designed by Albert Hirth, of Cannstatt-Stuttgart, Germany.

Fig. 1 illustrates its very original and simple principle of construction: The instrument is based on the use of a contact lever with arms of unequal lengths located on knives. No double lever transmission or step bearings are, therefore, used, thus avoiding any end play, as well as any oil layer liable to impair the accuracy of the apparatus. By regulating the distance of the two fulcrums of the lever, the deflection of the pointer fixed to the larger arm is increased or reduced, thus varying at will the ratio of movement. A spring presses the lever against the knives and after the reading has been taken, keeps it in its normal position.

FIG. 1. THE MINIMETER LEVER, POINTER AND SCALE

A tube inclosing the whole mechanism carries at its top end a glass plate and scale indicating the ratio of 1:100, 1:200, 1:500, etc., and along which the pointer of the contact lever moves. All vital parts of the instrument are made with precision from high-class case-hardened material.

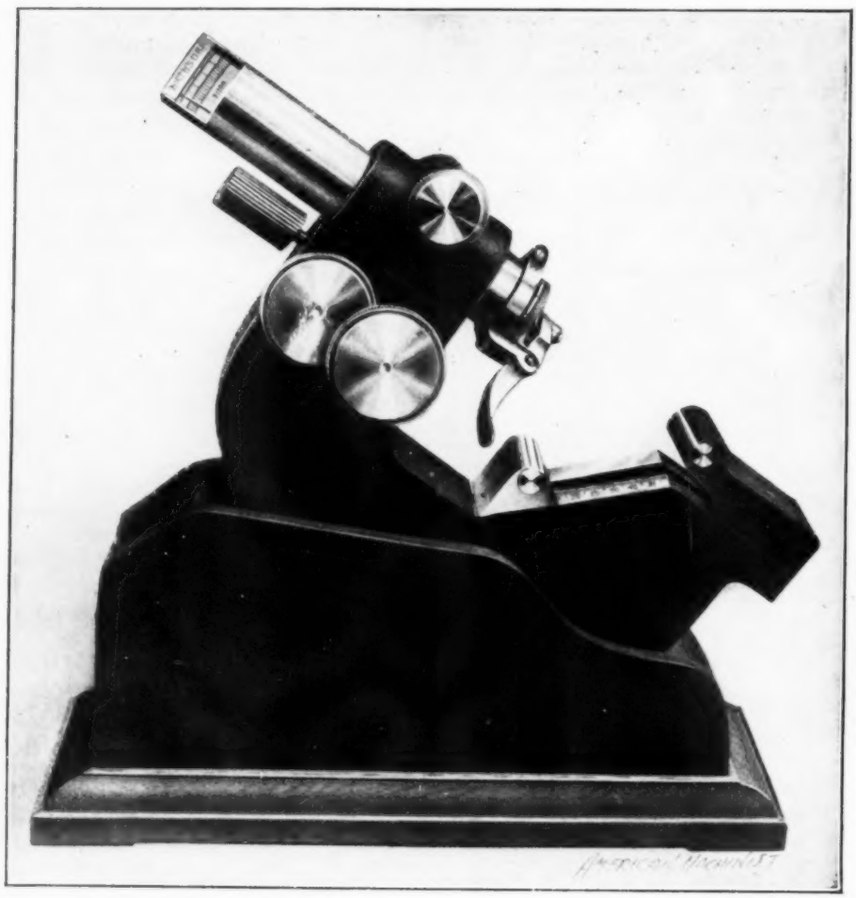


FIG. 2. THE MINIMETER COMPLETE, READY FOR USE

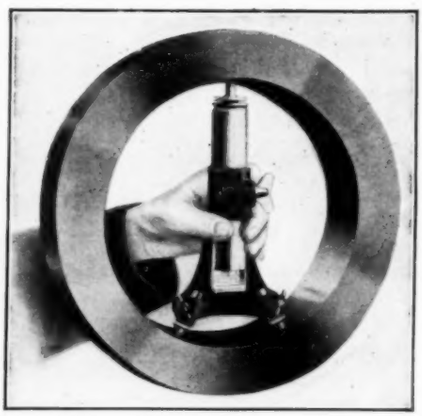


FIG. 3. MEASURING THE BORE OF A RING

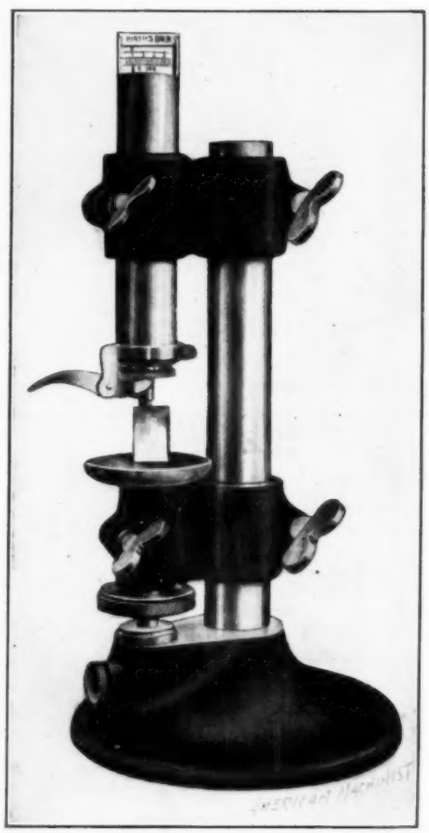


FIG. 4. INSTRUMENT ON UPRIGHT SUPPORT FOR GAGING FLAT WORK

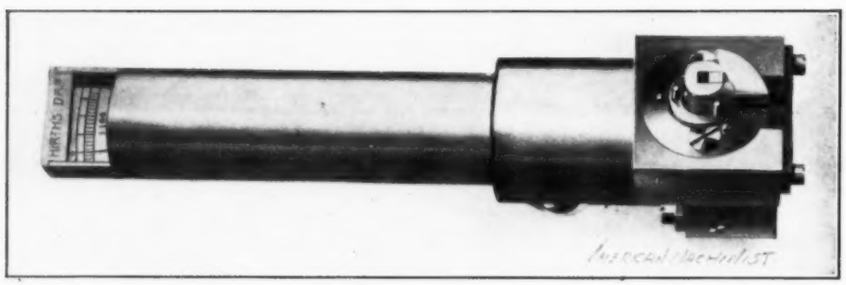


FIG. 5. DEVICE FOR SMALL INSIDE MEASUREMENTS

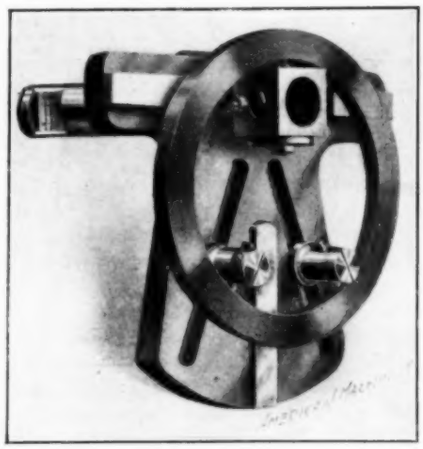


FIG. 6. INSIDE GAGE FOR RINGS

THE COMPLETE APPARATUS

Fig. 2 represents a complete measuring outfit designed on this system; this rests with its lower part in a wooden box. The clamp carrying the minimeter is adjusted by a screw visible on the top, by inserting standard gages or end gages. The two surfaces on which the object to be measured is rested are made of hardened and polished cylindrical pieces, thus preventing any loss of precision due to the wear of these surfaces. The jaw which carries the back support is adjusted according to the diameter of the object, by means of the scale visible in the illustration, which has been found very expedient for the measuring of objects of different dimensions.

The contact surface of the minimeter which, in the present case is made spherical, can as well be given a conical shape. The thrust lever clamped fast at the lower end of the minimeter tube allows the object to be readily introduced by a slight pressure of the finger, thus preventing any premature wear of the contact surface.

INSTRUMENT FOR LARGE WORK

Fig. 3 represents a minimeter designed for the measuring of objects having larger dimensions. The lower contact arm is provided with fine adjustment by means of a screw, the position of which is fixed by two nuts. The substantial bow of the apparatus is supported by a hinging wood block.

DEVICE WITH VERTICAL STAND

A specially convenient minimeter arrangement on a supporting column for the accurate measuring of surfaces is represented in Fig. 4. The measuring table is adjusted at will within given limits, by the nut fitted underneath, and the double clamp carrying the minimeter allows of a ready adjustment within wide limits both in a horizontal and vertical direction.

While the types above described are exclusively intended for outside measuring, the necessity of a practical and rapidly working measuring instrument of absolute precision for the far more difficult task of inside measuring has been even more keenly felt. Now the minimeter can be used to advantage also in this field of workshop practice.

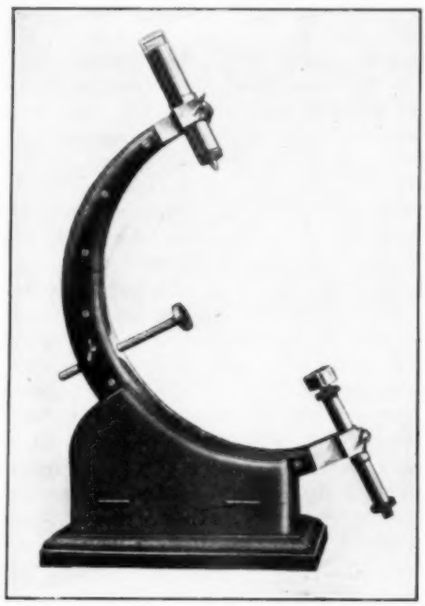


FIG. 8. MINIMETER FOR LARGE WORK

FIG. 7. SET OF INSIDE-GAGING INSTRUMENTS

DESIGN FOR INSIDE MEASUREMENTS

Fig. 5 represents a well designed minimeter for inside measurements on small objects. As the diameter of a circle is known to be accurately given by three contact points, two fixed spherical contact surfaces have been fitted to the cylindrical measuring pin, whereas the third contact surface is fixed to a lever arm located on knives. This lever arm is in contact in the interior of the casing, with a minimeter lever and on the measuring lever being acted upon, produces a deflection of the pointer in accordance with the actual ratio of transmission. The horizontal stops visible in the illustration are used in measuring rings, etc. The apparatus can be used for measuring objects of different diameters by changing the measuring pin.

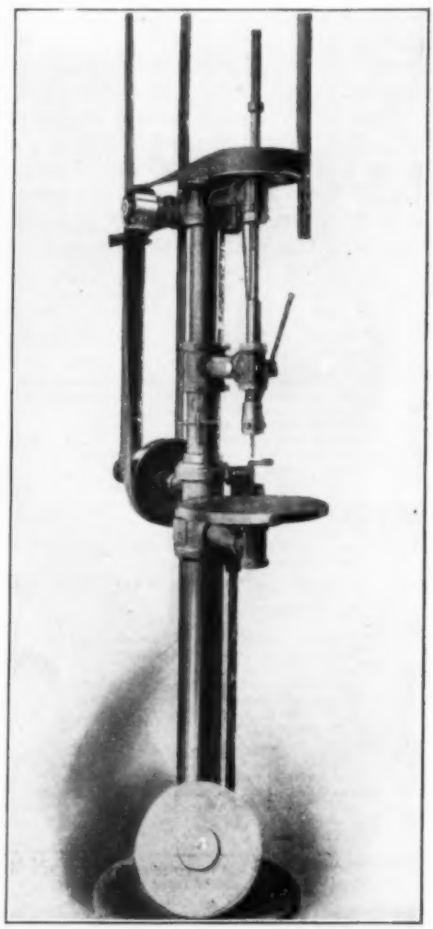
A special inside gage for ring-shaped objects is represented in Fig. 6. The minimeter is fixed to the upper socket which is clamped fast and the three contact pieces insure perfect location in the bore of the sample. The two slots visible in the engraving allow the instrument to be adjusted to different diameters within very wide limits.

Fig. 7 represents inside gages of different dimensions the range of which can be extended by exchanging the tubes, as far as 1000 millimeters. Fig. 8 illustrates the way these gages are used in measuring annular objects.

A Pipe Fitting Drill Press

BY WILLIAM WEAVER

The halftone shows a drill press which I built about two years ago. It is made almost entirely of pipe and pipe fittings, has been working every day since it was built and no repairs have been necessary. It will take drills up to 1 inch diameter.



A DRILL PRESS MADE OF PIPE AND FITTINGS

Duties on American Machinery in France

By A. J. Wolfe

On March 31, 1910, the new customs tariff recently adopted by the French Parliament went into effect in France. It was not until the last week in March that the official publication was made as to the extent of concession granted by the French Government in return for the non-enforcement of the maximum clause of the Payne tariff, and thus ended a long period of uncertainty which has prevailed as to the treatment that would be accorded to American imports into that country.

Before the new French customs tariff became a law various portions of it underwent a number of alterations, and our own tariff was changed necessitating the revocation of the Franco-American agreement. Under the circumstances it would be well to consider the whys and the wherefores of the changes, as well as their extent.

The new French customs tariff was prepared by a special tariff commission of the French Parliament. In the old French customs tariff there were two sets of duties, the general tariff and the minimum tariff. Almost all of the prominent commercial countries enjoyed the minimum rates of that tariff, with the exception of the United States. The consideration for the enjoyment of the lower rate consisted of important concessions. Germany, of course, enjoys perpetually the most favored nation treatment with regard to her imports into France, due to a clause to that effect in the Franco-Prussian peace treaty at the close of the war of 1870-1871. United States had a special agreement with France, as the result of which against certain concessions in the matter of import duties on French wines, etc., certain American goods, a small proportion of imports, enjoyed the lower rate. American machinery and manufactures of metal were not affected by these reductions and passed under the higher rates of the general tariff. When as the result of the passing of the Payne tariff the Franco-American commercial agreement was revoked, American machinery, etc., were in no way affected, but the anxiety centered around the question as to the treatment that would be accorded to these products (and all other American imports) under the new tariff.

Now the new French customs tariff as drafted by the commission above referred to had several aims in view: one was to afford better protection to domestic products by raising the minimum rates of duty wherever this was deemed necessary, then to offer inducements to nations to negotiate reciprocity treaties by raising the maximum rates or reducing the minimum rates, and on the whole leaving about 50 per cent. margin between the two schedules.

The French customs tariff bill was taken up by the French Chamber of deputies on October 27, 1909, and passed on December 29, 1909. It reached the Senate in February, 1910, and passed that body early in March. It went into effect on March 31. A number of items of the bill as proposed were changed by either of the two chambers, the other assenting, and in some instances the old tariff rates, in force to March 31, 1910, were restored.

On March 26, 1910, an official announcement was made at Washington of the articles of American manufacture, on which henceforth American products will receive the benefit of the lower rates, the so-called minimum tariff. The actual agreement had been signed a few days earlier, after the consultation between President Taft and his advisers and the French Ambassador. In return for these concessions France was included in the list of the nations "not unduly discriminating against the United States" in the matter of tariff rates, and thus entitled to import goods into the United States under the regular rates of our Payne tariff, that is without the application of the maximum clause provided therein.

The table below shows the duties which American machinery and parts of machinery will pay on entering France, the old rates of duty being also quoted for purposes of comparison.

For the proper understanding of the table it is necessary to remember the following points:

In the old French customs tariff American machinery passed under the high rates of the general tariff. In the New customs tariff of France some American goods pay the minimum rate, while others pay the maximum rate of duty, that is the general tariff rate. The new duties under which the American imports will enter France are shown by asterisk. German and British imports, both under the old and under the new tariffs, enjoy the minimum rates of duty.

The serial numbers at the left show the tariff section.

Duties are assessed at so many francs per 100 kilograms, one franc being equal to 19.3 cents, while 100 kilograms equal roughly 220 pounds.

	Old Tariff.	General. Francs per 100 Kilos.	Minimum. Francs per 100 Kilos.
505	Electrometers, water, gas and spinning mill meters, and in general all meters or measuring apparatus fitted with clock movements	100.00	75.00
	Machines and machinery:		
	Steam and other engines:		
510	Stationary steam engines, and machinery for steamships without the boilers; steam pumps, pumping machinery for gas, petroleum, hot or compressed air weighing:		
	250 kilogs. and more	18.00	12.00
	Less than 250 kilos	30.00	20.00
511	Steam engines, semi-fixed and portable, including the boilers	17.00	13.00
512	Locomotives, traction engines:		
	Ordinary gage	20.00	15.00
	Narrow gage	24.00	18.00
512 bis.—	Hydraulic machines with wheels, pistons, turbines, pumps, ventilators, weighing:		
	More than 3,000 kilos:		
	Containing at least 50 per cent. of cast iron		8.00
	Less than 50 per cent. of cast iron		10.00
	From 250 to 3,000 kilos	25.00	10.00
	Less than 250 kilos	50.00	15.00
513	Tenders for locomotive steam engines:		
	For ordinary gage	15.00	10.00
	For narrow gage	18.00	12.00
524	Dynamo-electric machines, weighing:		
	5,000 kilos. and upward and containing at least 50 per cent. of gray cast iron or cast steel	30.00	13.00
	Less than 50 per cent. of gray cast iron or cast steel	30.00	20.00
	From 2,000 kilos. inclusive to 5,000 kilos. exclusive and containing at least 50 per cent. of gray cast iron or cast steel	30.00	18.00
	Less than 50 per cent. of gray cast iron or steel	30.00	20.00
	From 1,000 kilos inclusive to 2,000 kilos exclusive	30.00	20.00
	From 50 kilos inclusive to 1,000 kilos exclusive	45.00	20.00
	From 10 kilos inclusive to 50 kilos exclusive	120.00	80.00
	From 5 to 10 kilos	150.00	100.00
	Less than 5 kilos	150.00	110.00
524 bis.—	Electric and electro-technical apparatus:		
	Containing coils of insulated metallic wire, and weighing:		
	1,000 kilos and more	50.00	30.00
	200 kilos inclusive to 1,000 kilos exclusive	120.00	45.00
	50 kilos inclusive to 200 exclusive	120.00	60.00
	10 kilos inclusive to 50 exclusive	120.00	80.00
	5 kilos to 10 exclusive	150.00	100.00
	Less than 5 kilos	150.00	110.00
	Containing coils of insulated metallic wire and weighing:		
	1,000 kilos and upward	50.00	30.00
	From 200 kilos inclusive to 1000 kilos exclusive	120.00	45.00
	From 50 kilos inclusive to 200 kilos exclusive	120.00	60.00
	From 10 kilos inclusive to 50 kilos exclusive	120.00	80.00
	From 5 kilos inclusive to 10 kilos exclusive	150.00	100.00
	Less than 5 kilos	150.00	110.00
	Not containing coils of insulated metallic wire and weighing:		
	1,000 kilos and upwards	45.00	20.00
	From 200 kilos inclusive to 1,000 kilos exclusive	45.00	30.00
	From 50 kilos inclusive to 200 kilos exclusive	120.00	40.00
	From 10 kilos inclusive to 50 kilos exclusive	120.00	60.00
	Less than 10 kilos	150.00	80.00
525	Machine tools:		
	Heavy, weighing more than 1,000 kilos	15.00	10.00
	Medium, weighing from 250 to 1,000 kilos	20.00	16.00
	Small, including articles of precision, weighing less than 250 kilos	70.00	50.00
525 bis.—	General machinery: Milling machinery, cylinder mills, machines for the manufacture of alimentary pastes, lifting apparatus, transmission gearing, gearing, scales, balances, steel rods and other ma-		

OLD TARIFF.

	General.	Minimum.
	Francs per 100 Kilos.	
terial used for sounding in mines, iron or cast-iron hollow tables used for cooling boiling sugar in sugar refineries, and known as "Kustner's Cold Tables," fixed railway stock, signals, presses, etc., apparatus not mentioned driven by mechanical power	15.00	10.00
526 Boilers: Steam boilers of sheet iron or of steel, plain or furnished with boilers, heaters or internal furnaces, but without heating tubes*	12.00	9.00
526 bis.— Steam boilers of sheet iron or of steel, tubular or semi-tubular, that is to say, having tubes whether of iron, steel, copper or brass*	18.00	14.00
526 c— Steam boilers, pieces thereof with many tubes, chiefly composed of tubes of iron or of steel, pierced together or not	24.00	18.00
526 d— Open boilers, gasometers, recipients, stoves and furnaces of sheet iron or of steel, or of cast and of sheet iron or steel	12.00	8.00
532 Other detached pieces of cast iron ,wrought iron or steel, not including parts for steam boilers:		
In cast iron, polished, filed or adjusted, weighing:		
1,000 kilos and more	18.00	12.00
From 200 to 1,000 kilos	20.00	15.00
Less than 200 kilos	25.00	20.00
533 Do. in wrought iron or in wrought or cast steel, polished, bored, turned, filed or adjusted, weighing:		
300 kilos or more	20.00	12.00
From 100 to 300 kilos	25.00	15.00
Less than 100 kilos but above 1 kilo	40.00	25.00
1 kilo or less	50.00	35.00

*Boiler-fittings (safety-valves, etc.) are not distinguished from the boilers to which they are attached, and are taxed the same. Cast iron furnace plates and bars are taxed separately and pay duties separately, at the rate of 3 francs 50 cents per 100 kilos (1s. 5d. per cwt.).

NEW TARIFF.

	General.	Minimum.
	Francs per 100 Kilos.	
505 Electrometers, water, gas and spinning mill meters, and all meters with clock movements	100.00	*75.00
510 Steam and other engines:		
Steam engines, stationary and marine, without boilers; stationary steam pumps, gas, petroleum, alcohol, hot air or compressed air motors and all other motors not specified, weighing:		
More than 100,000 kilos	18.00	*12.00
From 50,000 to 100,000 kilos	21.00	*14.00
From 1,000 to 50,000 kilos	24.00	*16.00
From 250 to 1,000 kilos	27.00	*18.00
From 100 to 250 kilos	39.00	*26.00
From 50 to 100 kilos	54.00	*36.00
Less than 50 kilos	60.00	*40.00
510 bis.— Turbines, steam, gas, petroleum or for any other gaseous or explosive mixture	45.00	*30.00
511 Steam engines, semi-stationary or locomobiles, including boilers	*21.00	14.00
512 Traction engines and road rollers, steam, petroleum, benzine, alcohol, etc	23.00	*15.00
Locomotives:		
Narrow gage	27.00	*18.00
Standard gage, with two cylinders	23.00	*15.00
Other	35.00	*23.00
512 bis.— Hydraulic engines, wheel, piston or turbine, weighing:		
Over 3,000 kilos and containing at least 50 per cent. cast iron	*25.00	8.00
Less than 50 per cent. cast iron	*25.00	10.00
From 250 to 3,000 kilos inclusive	*25.00	10.00
Less than 250 kilos	*50.00	15.00
[For the machines mentioned in Nos. 510 to 512 bis the importer must make a declaration stating the designation, weight and nature of component parts, as well as a plan or drawing of the machine. All incomplete machines assessed according to duty on detached parts. Machines without flywheels are considered complete. Flywheels imported separately pay duty as cast or wrought iron respectively.]		
512 ter.— Pumps and ventilators, weighing over 3,000 kilos and containing:		
At least 50 per cent. cast iron	*15.00	10.00
Less than 50 per cent. cast iron	*18.00	12.00
From 250 kilos to 3,000 kilos inclusive	*18.00	12.00
Less than 250 kilos	*27.00	18.00
513 Tenders for steam locomotives	18.00	*12.00
524 Same as old tariff. (American dynamo-electric machines still pay the maximum rate of duties.)		
524 bis.— Electric and electro-technical apparatus containing coils of insulated metallic wire and weighing:		
1,000 kilos and more	*50.00	30.00
200 kilos inclusive to 1,000 kilos exclusive	*70.00	45.00
50 kilos inclusive to 200 kilos exclusive	*90.00	60.00
10 kilos inclusive to 50 kilos exclusive	*120.00	80.00
5 kilos inclusive to 10 kilos exclusive	*150.00	100.00
Less than 5 kilos	*165.00	110.00
Not containing coils of insulated metallic wire and weighing:		
1,000 kilos and more	*30.00	20.00
200 kilos inclusive to 1,000 exclusive	*45.00	30.00
50 kilos inclusive to 200 exclusive	*60.00	40.00
10 kilos inclusive to 50 exclusive	*80.00	60.00
Less than 10 kilos	*120.00	80.00
525 Machine tools, weighing:		
More than 15,000 kilos	15.00	*10.00
From 5,000 to 15,000 kilos	18.00	*12.00
From 1,000 to 5,000 kilos	24.00	*16.00
From 250 to 1,000 kilos	36.00	*24.00
250 kilos and less	75.00	*50.00
[A collection of separate parts of machine tools shall be dutiable as separate parts of machine tools, or as the complete machine tool, whichever be the highest.]		
[The only tools which are allowed to be imported as an integral part of a machine tool are those which can be put simultaneously in the tool box of the machine tool, but not those used as duplicates.]		
525 bis.— General machinery: Milling machinery, cylinder mills, alimentary paste machines, hoisting machinery; transmissions, balances, scales, presses	*15.00	10.00
525 ter.— Typewriters, adding machines, cash registers:		
Weighing 50 kilos or more	300.00	*200.00
Less than 50 kilos	450.00	*300.00
525 quat.— Machines for rinsing, corking, placing capsules on bottles and bottling	30.00	*20.00
525 quin.— Charging apparatus and hoppers for furnaces, ladles for molten cast iron, cast iron mixers, converters, ladle cars, rolling mill trains, feeding cylinders for rolling mills	18.00	*12.00
525 sex.— Complete apparatus not specified	*15.00	10.00
526 Boilers: Steam boilers of steel or iron plate, simple or with heating tubes, feed water heater or internal fire boxes without tubes	*14.00	9.00
526 bis.— Steam boilers, tubular or semi-tubular	*21.00	14.00
526 ter.— Steam boilers, multitubular and elements thereof	*27.00	18.00
526 quar.— Open boilers, gasometers, radiators	12.00	*8.00
526 quin.— Boilers, heating plants for steam or hot water, including boilers; heating apparatus for oil, water heaters, with parts of copper in a proportion not exceeding 50 per cent. of total weight	*18.00	12.00
532 Detached pieces of machines and of transmission gearing, of non-malleable cast iron, turned, filed or fitted, weighing:		
More than 1,000 kilos	*18.00	12.00
More than 200 kilos up to 1,000 kilos	*22.50	15.00
200 kilos and less	*30.00	20.00
532 bis.— Cylinders for rolling mills, rough	*8.00	5.00
533 Separate pieces of machines, steering gear, brake apparatus and transmission gearing of wrought or swaged iron or steel, of cast iron or steel, or of malleable cast iron, of sheet iron, flanged or welded, weighing:		
More than 1,000 kilos:		
Rough	12.00	*8.00
Worked	20.00	*13.00
More than 300 to 1,000 kilos:		
Rough	15.00	*10.00
Worked	23.00	*15.00
More than 100 to 300 kilos;		
Rough	18.00	*12.00
Worked	26.00	*17.00
More than 15 to 100 kilos:		
Rough	21.00	14.00
Worked	38.00	25.00
More than 1 kilo to 15 kilos:		
Rough	24.00	*16.00
Worked	41.00	*27.00
Less than 1 kilo:		
Rough	30.00	*20.00
Worked	60.00	*40.00
533 ter.— Straight shafts, solid, weighing more than 1,000 kilos:		
Rough	*12.00	8.00
Worked	*15.00	10.00
From 100 to 1,000 kilos.		
Rough	*13.50	9.00
Worked	*18.00	12.00
From 10 to 100 kilos:		
Rough	*15.00	10.00
Worked	*23.00	16.00
Less than 10 kilos:		
Rough	*23.00	15.00
Worked	*30.00	20.00
533 quat.— Straight shafts, bored, bent shafts, crank shafts, weighing:		
More than 1,000 kilos:		
Rough	*15.00	10.00
Worked	*23.00	15.00
From 100 to 1,000 kilos;		
Rough	*18.00	12.00
Worked	*27.00	18.00
From 10 to 100 kilos:		
Rough	*23.00	15.00
Worked	*30.00	20.00
Less than 10 kilos:		
Rough	*30.00	20.00
Worked	*45.00	30.00
533 quin.— Parts of turbines (steam, gas, oil or any other gaseous or explosive mixture) worked, weighing:		
200 kilos or more	*45.00	30.00
Less than 200 kilos	*60.00	40.00
533 sex.— Separate parts of boilers:		
Rough	*20.00	30.00
Worked	*27.00	18.00
533 sept.— Balls for bearings, of a diameter:		
Over 10 mm	*37.00	25.00
5 to 10 mm	*90.00	60.00
Less than 5 mm., nickeled or not	*270.00	180.00

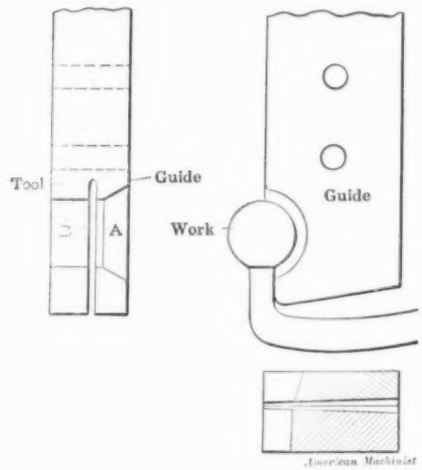
*Shows duties applicable to American goods.

Letters *from* Practical Men Concerning *the* Details *of* Making things *in* Machine shops, *from the* First Sketch *to the* Sale

A Ball Forming Tool

The accompanying sketch illustrates a tool recently made for finishing balls and necks on the ends of certain pieces which were too large to swing in our lathe.

A holding fixture was made for the boring-mill table, this being in the form of a vise with special jaws, and in setting the work central a hollow plug in the turret is brought down over the ball end and the fixture shifted until the work is centered under this hollow tool. The fixture is then clamped and the forming tool fed to the work. During this operation the turret itself is left unclamped and a bar carried in one of the upper holes kept in contact with a stop block by a weighted chain attached to the bar, this arrangement indicating when the tool is actually brought into its cut.



BALL-FORMING TOOL

The construction of the tool is plainly shown in the sketch. The guide plate is bell-mouthed as indicated at *A* and the cutting edge of the tool is seen at *B*. In operation it is impossible for the tool to bite more than it can safely cut as the guide plate *A* is only 0.010 inch below the cutting edge of the tool. We found the first day that the work could be done this way much quicker than a shorter and similar job had been handled in the lathe with an ordinary forming tool. It would of course be better where a good many pieces were to be finished to make the guide plate a fixture on the tool holder and make the tool itself wide and adjustable to the center.

WM. A. PHELPS.

St. Katheryns, Ont.

Pitch Diameters of Worm Wheels Below 30 Teeth

Though this matter is mentioned in most of the catalogs issued by gear-cutting firms, yet, from a considerable experience of cutting worms and worm wheels for the trade, it seems to me that several people who have these gears in their product do not realize the necessity of making the outside diameters of wheels having less than 30 teeth somewhat larger than the exact standard in order to prevent interference with the worm and to give a better finish to the wheel teeth.

Worm wheels of, say, 12 or 14 teeth, when made to standard diameters and cut with standard hobs, are badly undercut at the roots of the teeth. If the wheels are cut by the "sinking in" process of hobbing this undercutting takes the form of deep grooves in the roots of the teeth, and looks very bad. By suitably designing the worm and gear in the first instance, this can be altogether avoided and a stock hob may be used, thereby saving the cost of special hobs, which is a considerable item in the small orders.

The accompanying table has been designed to enable the draftsman to find the correct increase in diameter of worm wheels below 30 teeth to avoid this interference, and the consequent grooving when cutting.

The method of using table is quite simple, as follows:

a Calculate the pitch diameter by the ordinary rules.

b Multiply this pitch diameter by the factor given in the table corresponding to the number of teeth to be employed.

c Add the dimension obtained from *b* to the diameter obtained by *a*.

The increased pitch diameter so obtained is used for all further calculations respecting the gear; such as outside diameter, and centers at which worm and wheel are to work. The depth of tooth and other proportions of the worm and wheel teeth are exactly as the standard.

Two examples of working are given below for diametral and circular pitch.

1. Suppose a worm of 3 inches outside diameter 5 diametral pitch is to gear with a wheel of 20 teeth. The ordinary pitch diameter of the wheel is $\frac{20}{5} = 4$ inches. Referring to the table we find the factor for 20 teeth is 0.0330. Multiplying, $4 \times 0.0330 = 0.132$. Adding, $4 + 0.132 = 4.132$ inches. This is the pitch diameter on which calculations must be based.

A worm 3 inches outside diameter 5 diametral pitch has a pitch diameter of $3 - 0.4 = 2.6$ inches; therefore the centers are

$$\frac{4.132 = 2.6}{2} = 3.366 \textit{ inches}.$$

The usual calculation gives 3.3 inches center distance, and a bad gear. The table is equally applicable to circular pitch, having been put in the form given for this purpose.

Take a worm wheel 15 teeth $\frac{3}{8}$-inch pitch, the ordinary pitch diameter is

$$\frac{15 \times \frac{3}{8}}{3.1416} = 1.7904.$$

Factor for 15 teeth is 0.0663. $1.7904 \times 0.0663 = 0.1187$. Adding, we have $1.7904 + 0.1187 = 1.9091$ inches corrected pitch diameter.

It will be noticed in the table that two sets of factors are given for all numbers of teeth below 12. This is because, if we apply to these low numbers of teeth a correction in diameter which would do away with interference altogether we should, if the worm wheel was of fairly broad face, entirely cut away the outer points of the teeth owing to the two working faces of the teeth meeting at a point below the point line of the teeth.

To obviate this we compromise matters by putting up with a little interference in order to avoid sharp points on the tips of the teeth, and use as correction factors the smaller values in the table, which have been found in practice to give a good compromise on these broad-faced, low-numbered tooth wheels.

Teeth in Wheel.	Factor.	Compromise Factor.
8	0.1830	0.1413
9	0.1552	0.1275
10	0.1330	0.1163
11	0.1148	0.1072
12	0.0997	
13	0.0869	
14	0.0759	
15	0.0663	
16	0.0580	
17	0.0507	
18	0.0441	
19	0.0383	
20	0.0330	
21	0.0283	
22	0.0239	
23	0.0200	
24	0.0163	
25	0.0130	
26	0.0099	
27	0.0071	
28	0.0044	
29	0.0020	

WORM WHEELS BELOW 30 TEETH.
INCREASE IN PITCH DIAMETER TO ELIMINATE INTERFERENCE.

Rule: Multiply pitch diameter by factor in table and add result to original pitch diameter.

Bristol, Eng. J. BUTTERWORTH.

Mechanical Features of Electric Driving Shops* *By John Riddell*†

It is with the mechanical features of motor driving that this paper is to deal, and chiefly with what has been done in the electrical equipment of the most commonly used machine tools in the plant of the General Electric Company, at Schenectady, with a few sketches of some large work that has been erected outside.

Some 10 or 12 years years ago it was decided to erect a large and uptodate electrically driven machine shop, and plans were started some time ahead of the completion of the building. At first the plan was to have every machine tool individually driven, but the time was so short that we abandoned this idea and concluded to arrange the machines in groups, driven by a motor direct-coupled to the end of a section of lineshaft. This arrangement was used only to take care of small and medium-sized machines, of which few, if any, were at that time equipped with individual motors.

Considerable difficulty was experienced in arranging the lineshafts and countershafts in this system, owing to their being traversed by small side-bay electric cranes.

One of the mechanical difficulties encountered in attaching individual motors to small machines was the unwieldy size of some of the earlier motors of small capacity. Sometimes the motor would be as large or larger than the machine and this feature was largely responsible for the prevalence of group-driving of small machines, even where the individual drive would have been preferred. Recent improvement in motor design has led to a great reduction in the size of motors for a given capacity, so that the 25-horsepower motor of today is not nearly so large as the 10-horsepower motor of earlier years. It is therefore much easier now to make the motor an integral part of the machine; and even where only fractional parts of a horsepower are required for light operations, suitable motors of very small weight and now available which are well adapted in size to the smallest tools.

Small Machine Tools

In good examples of individual motor drives, the motors are inconspicuous and form integral parts of the machine tools; a lathe driven by an induction motor concealed in the cabinet leg; a wood-boring machine driven by an induction motor through a single pair of bevel gears. The inverted motor is bolted to a plate, which is in turn bolted to the bottom of a post and to the frame of the tool. At first, the plate was arranged to swivel on the tool post in order to provide means for moving the tool longitudinally over the work; but later this adjustment was abandoned as it proved to be easier to move the work horizontally with reference to the tool. This tool is a good example of the compactness of the electric motor, and its easy adaptability to wood-working machinery.

Large Machine Tools

The large lathes, vertical boring mills, planers, milling machines, etc., were supplied each with its own individual motor, which was a marked improvement over the original belt-and-countershaft methods of driving. Since starting this work, the company has changed over several thousand machine tools to motor drives. Most of the difficulties in changing from belt to motor driving were in making suitable connections between the motor and the tool to be driven. We do not pretend that in every case we have adopted the best arrangement, as in many cases the machine tool is not of sufficient value to warrant an expensive mechanical connection.

Take, for example, a medium-sized lathe of relatively moderate value. If an expensive transmission device was required in order to apply a motor to the lathe, the total cost of the lathe, as changed, might easily be more than the price of a new lathe especially designed for motor driving. In such cases it is found expedient to erect the countershaft and cone about four feet above the headstock, on suitable brackets, fasten the motor in a convenient place on the machine, and continue the use of cones and belts.

In all cases where old machine tools are converted to electric driving, it is desirable to mount the motor on some part of the machine, if possible, rather than on the floor near the machine. In the former case, the machine tool constitutes an independent self-contained unit which can be moved by the crane as a whole and located wherever desired. Cleanliness is promoted, by leaving a clear floor space to sweep, and the motor is less liable to accumulations of dirt caused by sweeping. There is also a tendency for the motor and the machine tool to become shifted out of alinement, if they are separately mounted on the floor.

For lathes of more importance, where the value of the tool warrants, we make an all-gear drive, with reversing gears, which are used principally for screw cutting. More recently we have produced motors which can be very quickly reversed, obviating the necessity of reversing gears.

When the original change was made from belt to motor drive, there was one particular triple-geared lathe, 72-inch swing, to which we applied a two-to-one variable speed motor. The only change necessary in this case was to substitute two gears for the lathe cone, mounted on a quill and made to engage with a pair of rocking gears on the motor. This gave a speed variation of four to one at the motor, and with the triple gears of the lathe, we had an exceedingly fine speed range.

In a shafting department like that of the General Electric Company, where the range of size does not vary over three or four inches on the standard work, no very great speed changes are necessary, and a two-to-one motor usually has range enough to meet all requirements. What is particularly needed is ample power, strength of parts, and simplicity of construction, especially in lathes used for roughing, which are usually handled by unskilled labor.

For finishing shafts, however, where greater accuracy is required, an all-gear drive with steel gears is not satisfactory, because the chattering set up by the action of the gear teeth is very apt to be transmitted to the finished work, leaving parallel ridges. This difficulty was overcome in some special lathes which we had built for the purpose, in which the driving gear on the main spindle was left loose and acted on the driving plate, keyed to the spindle, through four rubber buffers.

More recently, trouble from this same cause was experienced in one of our tool departments, and was corrected by the use of a pinion made of muslin. This pinion has several features which specially adapt it to motor-driven machine tools. It is practically noiseless and very durable, does not shrink, and is sufficiently flexible and elastic to absorb vibrations which might be transmitted to the finished work.

Another application to motor driving in connection with lathes, and one that has been much appreciated, is the use of an auxiliary motor to operate lathe carriages having a long travel, of about 35 feet. The motor is bolted to one side of the carriage and carries a pinion which meshes with the hand-wheel gear. A two-way switch is provided for operating the motor in either direction. The use of a motor not only saves the operator a difficult task, but it has also proved a great economy of time. It formerly required 30 to 35 minutes to shift the carriage through its full travel, and the hand wheels were placed so low that a man had to stoop to use them. The motor will move the carriage from one end of the lathe to the other in a minute and a half and it can be stopped at any point within a 1/16 inch of the cut.

*Condensed from *Journal* of American Society of Mechanical Engineers.

†Mechanical superintendent General Electric Company, Schenectady, N. Y.

The best location for a motor on a lathe and on most machine tools, is as low down on the machine as possible. The amplitude of the vibrations set up will be smaller, the closer the motor is to the floor, and the liability of chattering will therefore be reduced. The location of the motor in the cabinet leg, or in the headstock of a lathe is ideal, but there are, of course, many cases where the motor must be mounted over the headstock because no other place is available. The necessity of having the motor out of the way of the work is obvious, as turnings of chips, if allowed to get into the motor, would at once give rise to electrical troubles, especially in direct-current machines.

Controllers

The location and arrangement of controllers for lathes depend upon the class of work to be performed. Where the lathe is started, stopped, and varied in speed by the controller, the latter should be mounted on the front of the lathe, and the handle extended by means of a shaft to the lathe carriage where it will be constantly under the hand of the operator. Ease of control unquestionably results in the rapid and economical production of work. Where the work varies considerably in diameter, frequent changes of speed will be required, and where the most efficient cutting speed can be obtained by simply turning a conveniently located handle, the work will be turned out at a maximum speed. If frequent shifting of belts is required, a great deal of the work will be done at less than maximum speed, owing to the extra exertion involved.

For lathes with constant-speed motors operated with clutches and shifting levers, or machines on which continuous automatic operations are carried on, such as screw machines, the motor can be kept running for long periods without attention from the operator. In such cases the controller may be mounted at any convenient place on the machine, or near by on the floor, by means of a bracket.

Planers

In the application of motors to driving planers at the Schenectady shops, the first step was simply to discard the line-shaft and drive the countershaft from a motor placed on the floor. When this planer was operated by belts it was next to impossible to reverse it in a shorter space than about 30 inches, and even then with a great deal of wear and tear on the belts. Early in 1900 the company produced its first magnetic clutches for driving planers. The first of these clutches was applied to a Bement-Miles planer, 10 feet wide by 20 feet long. With this clutch we are able to reverse the planer practically to a line and to reduce the space required for reversing to about 12 inches. Some trouble was experienced, however, with these first magnetic clutches, owing to the design of the magnets and pneumatic clutches of a peculiar design were subsequently adopted and have been entirely satisfactory.

Our second lot of magnetic clutches was redesigned to eliminate the difficulties experienced with the first lot, and the new ones were applied to a number of portable slotters. These machines have been in continuous operation practically night and day up to the present time. The clutches have operated with entire success, and I believe the magnetic clutch will eventually be found an important and efficient feature of transmission gears for planers and slotters.

Vertical Boring Mills

In our original scheme for attaching motors direct to boring mills, an all-gear drive, with variable-speed motors, was selected, and with very slight changes, has been employed up to the present time. A solid foundation is laid, extending under the entire machine, a depression in the back between the side frames forming a bed for the motor, which is securely fixed in position. This common foundation makes the motor and the machine a single compact unit, and no additional floor space is required for the motor. No work put upon the table can interfere with the motor, the gears are entirely out of sight, and the controller is placed at the right-hand side of the machine, where the operator usually stands.

On boring mills from 20 to 25 feet in diameter, with the usual slow intermediate and direct-gear drive that comes with the mill, a variable-speed motor of two-to-one ratio gives a very satisfactory speed range.

Portable Tools

Various machine tools of the portable type are used in ordinary large machine shops, and are placed in various positions on iron floor plates. The efficiency of these machines, such as rotary planers, slotters, etc., used in erecting departments, has been greatly increased by the use of electric motors. The use of portable tools was almost impossible before the advent of the electric motor, but now the machine tools used in erecting shops, and in isolated places away from the source of power, when equipped with electric motors are ready to run at a moment's notice. On uptodate rotary planers the motor is placed on the carriage; the underside of the bases is planed, and means are provided for transferring the planers by electric cranes.

Under the old arrangement, if machinery stood idle for days and weeks, the countershafts and loose pulleys were so neglected that they would squeak; someone would then throw off the belts to stop the noise, and two hours' work was frequently necessary before they could be started for a hurried job. The same thing is true of some boilermakers' and blacksmiths' machines, such as rolls, shears, cutting-off machines, etc.

Belting

Twenty-five or 30 years ago, in the days of the old jobbing shop, the buildings were not so high-studded, and the line shafts and countershafts were usually within reach of a 12- or 15-foot ladder at the most. Cone belts running to machine tools were very easily manipulated, and an expert lathe hand would never think of using a pole for shifting his belt from one step of the cone to another. But in these days of sanitary buildings, with ceilings from 20 to 25 feet high, it becomes an exceedingly difficult problem to arrange countershafts within reasonable hights; to say nothing of the necessary length of the vertical belts, the dust set in motion, and the difficulty of painting and whitewashing ceilings for the sake of cleanliness.

Another condition of line-shaft driving which has not been much spoken of, of late, is the difficulty of keeping the shaft in alinement, where the hangers are suspended from the roof trusses. The writer has seen such shafts five or six inches out of alinement, due to a heavy fall of snow on the roof, or to the settling of foundations. Another trouble is due to State laws and shop rulings, where a few trained men are employed as belt lacers, and it is against the rules for men who are not belt lacers to do the work. This is the cause of numerous delays, with consequent loss of production.

The only advantages that may be claimed for belts is that they take up the vibration of the gears, and thus prevent chatter marks on fine work; and that they will slip under overload and be thrown off the pulley, stalling the machine, instead of breaking the tool or spoiling the work. It has already been explained how the effect of vibration has been remedied by means of rubber buffers or muslin pinions, and there are exceedingly few cases where belt-slip is not a detriment rather than an advantage. The use of high-speed tools calls for a considerable increase in the power necessary to drive the machines, as these tools take a heavier cut at a higher speed than those of carbon steel. These conditions make belt-slip very objectionable, and one of the chief advantages of motor driving is that it increases the power of machine tools beyond the capacity of belts of reasonable length. Modern practice is in the direction of eliminating the belt almost entirely, although there are a few machine tools, such as the older types of automatic screw machines, grinding machines and some wood-working machines, on which they are necessarily retained.

The great majority of metal-working machines are best adapted to motor driving through all-gear connections, although a few machines, such as small grinders, buffing wheels, polishing wheels, etc., are best connected direct to the motor shaft.

At the Schenectady plant alone we have running some 8500 machine tools, of which 8150 are individually motor driven. Group driving has been adopted for some sensitive drills, speed lathes, and other small miscellaneous machines. Of the above tools there are 48 portable machines, consisting of slotters, milling and drilling machines, radial drills, etc. These machines are operated on 32,675 square feet of iron floor plate, in addition to which there are 7000 square feet of iron rails, cemented into the floor, for erecting purposes.

Had we continued our extensions since 1899, using line shafts, countershafts and belting, we would have approximately 34,570 feet of line shaft, or about 6½ miles, and about 4¾ miles of countershaft which would require about 21,225 hangers and bearings. Allowing two belts to each machine, with an average length of 25 feet per belt, we would have for the 8500 machines a total of 425,000 feet of belting, equal to about 80½ miles.

Helical Timing Gears for Automobiles

By Chas. E. Crofoot

One of the most important problems in modern automobile construction, and one which has received a great deal of attention from mechanical engineers the past few years, is the obtaining of quietness of the running parts. Next to the engine, the gears of a car have proved the greatest offenders in the way of noise.

Transmission gears have been very much improved by the adoption of the generated spur tooth, and bevel differential and driving gears are now almost universally cut on the bevel gear generators. These machines conjugate the teeth, and exact curves are obtained for any number and ratio of teeth. Heretofore, tooth curves have been only approximately correct; those of spur teeth being included in the range of 8 cutters for each pitch, and bevel tooth, with the added complicacy of varying pitch as the teeth approach the apex, have been limited to fixed formers laid out to cover a wide range of ratios.

It may be said of the generating process that it is the only theoretically correct method of gear cutting, the accuracy to be obtained by this method is only limited by degree of perfection of the form of the cutting tools, and of the machine itself. Modern gear generating and hobbing machines are acknowledged to be masterpieces of machine design.

With the transmission differential and driving gears well taken care of, we come to those little racket makers, the timing gears. In an attempt to eliminate this disagreeable feature, various noise deadening materials, reinforced by metal centers and flanges, have been used in their construction. Rawhide has proved a failure on account of its susceptibility to the decaying action of oil, resulting in the ultimate complete destruction of the gear teeth. Fiber has proved but slightly more satisfactory on account of the swelling action of moisture. Furthermore, as neither material wears well under ideal conditions, they have both been practically discarded.

Fairly good results have been obtained by the use of straight-cut, generated spur teeth where the design of the gears and combination of materials is good, but how often is the latter true?

The engineer has the following to consider in designing automobile timing gears: style (spoked, webbed or plain), material, pitch, face, ratio and kind of teeth.

It has been determined by extensive experimenting that a webbed gear will make less noise than a spoked gear, particularly if the material is bronze. If a spoked design for cam shaft or idler gear is desired, to secure lightness not more than four well ribbed spokes should be used, and these should be wide and flat and ribbed both sides, with good fillets. The crank-shaft gear with its large hole, is best made solid, and the magneto gear lightened up for its small shaft by webbing.

The meshing of two gears of the same metal, as steel and steel, bronze and bronze, is to be avoided on account of the production of excessive noise and wear.

The action of steel and bronze has long been conceded to be the most perfect obtainable, but on account of the metallic ring of the latter, even if the gear is made webbed, other metals have been tried in an effort to reduce the noise. Cast iron has so far proved the most successful, and has the added advantage of being much less expensive. Notwithstanding considerable prejudice at first against its use, cast iron has proved a reliable material when of good quality. So far we have an inexpensive and good wearing, and fairly quiet set of timing gears, if properly designed as to pitch and face.

We now come to the latest advance in modern gear practice, that of the commercial use of the helical form of tooth. Although known for many years, the expense of cutting and a certain amount of prejudice and ignorance of its true worth, has kept it in the background.

The invention of modern hobbing methods and machines has given us the theoretically perfect helical gear, at only a slight increase of cost in quantities over spur gears. Timing gears, of correct design and material, cut by this method, have proved practically noiseless, and the helical tooth is being adopted for these gears by many of the best manufacturers, and will shortly be almost universally used. The question of noise will probably never be entirely eliminated, but its minimum has probably now been reached.

Practically the only objection to its use is the end thrust, caused by the angular cut of the teeth. Inasmuch as the power transmitted by timing gears is light, this end thrust is not excessive and is easily taken care of by proper thrust bearings. In this case it is not necessary to resort to the double helical or herringbone type for the elimination of this trouble.

On the other hand, the helical tooth has many qualities that commend its use for automobile timing gears. The action of this form is at once smooth and more positive than the straight spur cut. This is a great advantage for timer gears; the violent starting and stopping of the engine subject them to severe shocks which in time is ruinous.

Inasmuch as helical teeth have a sliding engagement and better surface contact, they run with less vibration and consequently less noise. The teeth in contact may be described as folding into each other, a tooth sliding into a space, instead of one tooth striking another, as is the case with spur gears. This sliding action also puts a glaze on the teeth, which is one of the secrets of the wearing qualities of cast iron when used for these gears.

In adopting this type of gear in place of spur gears now used, or in working out new plans for a new car, it will be well to consider the proper design in addition to the points in regard to style and choice of material, already mentioned.

The angle of teeth, pitch, and width of face should be taken into consideration. The two latter will, of course, vary with the size and power of the car. At first the tendency was for designers to adopt 45 degree angle, or from this down to 30 degrees. Experience has proved these angles to be too great on account of excessive end thrust and consequent wear. The best practice is the use of an angle of from 12 degrees to 20 degrees, with a face sufficient to gain at least one tooth; too narrow a face is generally used. Not only does a wide face in-

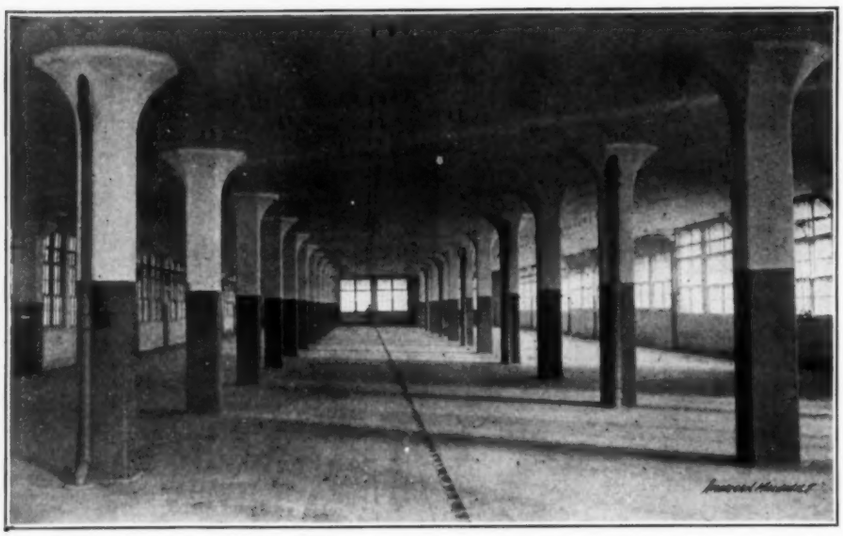
crease the bearing surface of overlapping teeth, thus tending to steady the gear in its action, and lessening vibration and noise, but it gives the teeth greater strength to resist the shocks resulting from the sudden starting and stopping of the engine. A face of 1 to 1¼ inches is now used in place of ¾ to ⅞ inch, as formerly. The pitch to be used will vary from 12 diametral pitch for light cars to 8 diametral pitch for heavy types. The general tendency is to use too coarse a pitch. It is better to increase the face, rather than the pitch, if gears are found to be too light. The finer the pitch, the more teeth there are in contact, and the quieter the gears. Judgment must be used in this, taking into consideration the speed and power.

With well designed and accurately cut helical gears, run under proper conditions of mounting and lubrication, no manufacturer of high-grade cars need experience any trouble from noisy timing gears.

The hobbing process for helical gears, although not yet absolutely perfect, has gone a long way in the solution of the problem of "noiseless" timer gears, at a reasonable cost.

Mechanical Features in a Recently Completed Concrete Building

The new storage building of Pierce-Arrow Motor Car Company, of Buffalo, N. Y., contains three rather novel and interesting mechanical features. Two of them deal with the question of machinery installation, as this building may at some later date be used for manufacturing purposes. The floors are of the girderless or mushroom type. Consequently it is possible to run overhead trolley tracks, heating pipes, or shafting in any directions desired. Through the center of each bay and extending the full length of the building, inverted U-bolts are placed over the reinforcing rods of the floor slab of the story above, and extend four inches below the ceiling line.



ARRANGEMENT OF TROLLEY HANGERS IN CONCRETE CONSTRUCTION

Each bolt spans three reinforcing rods; the exposed ends are threaded their entire length. For the present these bolts are to support trolley tracks but shafting can be supported very readily should it ever be necessary. The two top stories have wood top floors to which machinery can readily be attached.

These top floors are very firmly locked down by 3x4 sleepers with beveled edges, which have 1/16x2x12-inch steel bands fastened to their under side every 12 inches. The structural concrete was cleaned with a sand blast, these sleepers placed on 16-inch centers, running across the building, and the space between filled with a 1:3:6 mixture of gravel concrete.

The third of the novel features are the pilaster flues which distribute the hot air of the indirect blower heating system from the tunnel underneath the ground floor to the second, third and fourth stories.

The exterior concrete columns on one side of the building are cast with a channel-shaped cross-section. The vertical risers leading to each floor are formed by bricking up the outside of these pilasters. Communication is had with each floor by means of registers and dampers.

A remarkable feature of this building was the speed with which the contractors, the Aberthaw Construction Company, of Boston, Mass., completed it. The building is four stories, containing 107,500 square feet of floor space and it was delivered to the owners ready for occupancy three months after work was started. The accompanying halftone shows the arrangement of the trolley hangers and the finished floor of the third story.

The mushroom type of reinforced concrete floor has advantages from a structural standpoint over the girder type. The floor hights can be less with an equivalent clear head room; it is much easier and cheaper to construct; and further the slabs can be made lighter for a given floor load as a flat plate supported at four points is stronger than the same plate supported on four sides. The difficulty of supporting shaft, etc., from a girderless ceiling is apparently obviated by the method described above.

Fireproofing as Trade Insurance

The business prudence of putting up really fireproof buildings for manufacturing purposes has been rather forcibly and briskly presented by M. C. Tuttle, of the Aberthaw Construction Company, of Boston, in an article in *Advertising and Selling*, under the title "Fireproofing a Good Name." The point of Mr. Tuttle's argument is that wherever any article has obtained a wide market under a trade name, it is of first importance to keep up the supply of that article. Any serious interruption in the supply caused by the destruction of the factory, and the long gap in production that nearly always follows, is presented as a more serious set-back than can be repaired by insurance money. The insurance may pay for the factory and machines, but it cannot make up, it is argued, for the loss due to inability for some weeks or months, to furnish a trade-named article.

There is obvious soundness in this proposition, so far as it concerns factories making trade-named articles, and the policy has its value even in the case of textile mills, whose market is increasingly dependent on keeping a trade name constantly in the public mind. The fireproof building costs more than the best type of slow-burning construction; insurance rates on it are little if any more favorable; and there are fewer engineers and builders really competent to produce the fireproof structure. Yet this type is being increasingly adopted, and Mr. Tuttle gives a convincing reason for it. When a factory burns up, and has to be quickly rebuilt, in addition to replacing machines, the operating force loses efficiency for a time by the interruption. If the factory stays around—and a fireproof building should endure the burning of its contents—the replacing of machines is a relatively quick matter.

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Contents

PAGE

Davenport Multi-spindle Automatic Screw Machine..... 669
Unexpected Results from a Cost System.... 674
Some Old Machine Tools..... 675
Unusual Results Obtained by the Use of High Speed Steel..... 676
Stock Wise—Labor Folish..... 678
Compulsory Working of German Patents... 679
Amsler Hardness Testing Machine and Cone Attachment..... 681
Cutting an Unusually Accurate Worm Wheel 682
Action and Design of Four Cycle Marine Gas Engines..... 683
The Melville Macalpine Reduction Gear.... 687
An Inside View of the Apprenticeship Question..... 688
Some Curious Effects of Hydraulic Pressure. 689
Malleable Steel Castings..... 690
Theory of Impulse Pumping and Construction of Pumps..... 691
Testing Pressures with Lead Cylinders—Revised Table..... 695
Cleaning and Polishing Brass..... 695
A Novel Fine-Measuring Machine..... 696
Duties on American Machinery in France... 698
Letters from Practical Men:
A Ball Forming Tool....Pitch Diameters of Worm Wheels Below 30 Teeth... 700
Mechanical Features of Electric Driving Shop 701
Helical Timing Gears for Automobiles..... 703
Evolution of Surfacing Methods..... 705
Proposed Museum of American Mechanic Arts..... 705
New Tools and Machine Shop Appliances... 707

American Machinist

Editorial

Evolution of Surfacing Methods

Without going back to exact dates we can say that the last hundred years have seen the surfacing of metals pass through all of its stages. Beginning with the chipping hammer, the cold chisel and the file, then came the planer, which held undisputed sway for many years, the milling machine and now the grinder. For, while we have long used the surface grinder for grinding work and some of the more progressive are finishing round work from the rough by this method, the use of the grinder for surfacing flat work in place of either planing or milling was confined to disk grinders until within a year or so.

The disk grinder paved the way by showing what was possible in the way of finishing comparatively small surfaces from the rough and was the forerunner of the large machines with moving work tables, having both vertical and horizontal spindles. Each of these have a special field in classes of work which can be handled in one position better than another, in addition to a common field in which the work can probably be done equally well on both.

The use of large wheels of the cylinder or ring type gives high cutting speed without undue speed of the spindle, and is economical of grinding material. Some of the results obtained are remarkable and must be gratifying to the designers and builders but, bearing in mind the over enthusiasm of former days when the milling machine became a fixture in manufacturing, we trust they will not fall into the same error.

It does not take a mechanic with very gray hairs to remember the over-enthusiasm of the milling-machine advocates when this machine began to take its place in manufacturing operations. The files of the AMERICAN MACHINIST of perhaps twenty-five years ago, will show predictions that the planer was soon to be obsolete, consigned to the same scrap pile that our electrical friends have had picked out for the steam locomotive ever since the first electric motor managed to move a car. But both the locomotive and the planer are still very much in evidence in spite of the fact that the milling machine and the motor are doing more wonderful work than ever the enthusiasts of the older days dreamed of.

The same is likely to be true of the new grinders and in fact of all types of machines. They will take some of the work away from the older machines, how much only time can tell, but both the planer and the milling machine will continue to be built and used. True, they may be confined to fewer classes of work, just as the modern shop man is usually restricted to running one of a few types of machines instead of being a machinist in the old sense of the word. But this is a tendency of all manufacturing, and while it has drawbacks, it allows both the operator and the machine to concentrate attention so as to secure better results along these particular lines.

Proposed Museum of American Mechanic Arts

We are heartily in sympathy with the suggestion contained in a letter written by John Riddell to the president and council of the American Society of Mechanical Engineers ,that some action be taken to establish a museum of mechanic arts. Great inventions and developments have usually been international in character, and American engineers have contributed much. No argument is needed to show that their works should be preserved, both for their historic interest and engineering value. The important thing to urge is immediate carefully planned action. Mr. Riddell rightly points out that much material that is available today cannot be had 10 years hence. In the field of machine tools we know that there is much that can be obtained, as we have from time to time published articles describing early and noteworthy developments; yet our investigations have shown only too plainly that a large amount of material once available, has been lost forever.

The reference to the South Kensington Museum where are preserved the epoch-making inventions of Watt and Stephenson, at once raises the question, is not the proper place for such a collection the Smithsonian Institution at Washington?

The expense of establishing and maintaining an exhibit that would adequately cover the beginnings and growth of mechanic arts in this country might be a severe tax on the resources of any professional society or even group of societies. Nationalized, and the question of support would be solved.

In any event, the need of such a museum is real, and we are heartily in sympathy with any movement that will bring about its establishment, provided the plans are adequate to gather together and preserve inventions and mechanical devices in all lines of industry. Again we counsel that action should be immediate.

Following is the text of Mr. Riddell's letter:

The rapid advancement in mechanic arts in this country causes machinery and mechanical devices to be quickly superseded by newer developments. Such superseded devices are often most interesting, in studying the development of engineering, but unfortunately, such devices disappear, leaving no record of what has been done. Think for a moment how interesting it would be to have the original and a few intervening forms of such American devices as the cotton gin, and a few of the numerous machines which we have made for harvesting cotton, the sewing machine, telephone, phonograph, linotype, telegraph, aëroplane, and other machines, while not of American origin, but to which we have greatly contributed in their development —as the steam engine, plow, machine tools, general automatic machinery, bicycle, automobile, steam turbine, electric dynamo, and steel mill machinery.

In the South Kensington Museum the epoch-making inventions of Watt and Stephenson are carefully preserved, and visited by thousands of people from all civilized countries.

American engineers have contributed so much to this work that it is appropriate that a record of the most important developments should be kept. I have thought for some time that a movement should be put on foot to establish a museum of mechanic arts, and that it is most appropriate that this should be done by The American Society of Mechanical Engineers.

It is important if anything is to be done in this line, that action should not be delayed, since it will be readily understood that much material is available for such a museum now that could not be had ten years hence.

I am prompted to make this suggestion in view of the forthcoming trip abroad by many of your members, and I might also suggest that some investigations and report be made on the feasibility of such a scheme.

Yours truly,

(*Signed*) JOHN RIDDELL.

Weakness of United States Patents

From time to time we have printed various articles calling attention to our American patent situation, and in some cases suggesting reform. It is frequently stated that American patents are weak, and that of patents brought into litigation many are declared invalid.

In this connection a paragraph from an argument made by Frank L. Dyer, before the committee on patents in the House of Representatives, on House Bill 12,368, To Amend the Statute Relating to Patents and the Patent System, is worthy of careful reading. This paragraph summarizes the decisions in regard to 427 patents that were litigated in the first instance, and 340 on appeal between May, 1906, and January, 1910.

We read: "I find from *Federal Reporter*, Volume 142 (May and June, 1906), to *Federal Reporter*, Volume 173 (December, 1909, and January, 1910), that there were 427 patents litigated. Of that number 126, or 29 per cent., were held to be invalid—I might say parenthetically that it is fair to assume when a patent is brought to court that the patentee has a reasonable hope of sustaining it so that the percentage of invalid patents as a whole is probably greater—166, or 39 per cent., were held to be infringed, 149, or 35 per cent. were held to be not infringed. In other words, more than 60 per cent. of the patents litigated in these four years, were held either to be invalid or not infringed, as since the courts endeavor as far as possible to sustain patents, the probabilities are that if they were compelled to hold and some of these patents were infringed many of that number would have been held to be invalid. In the same reports on appeal to the Circuit court of appeals, 340 patents were litigated; 121, or 35.6 per cent., were held to be invalid; 125, or 36.8 per cent., were held to be infringed, and 114, or 33.5 per cent., were held not to be infringed."

Meeting of Southern and American Supply and Machinery Dealers Association

A joint meeting of the Southern and the American Supply and Machinery Dealers' Association, was held in Jacksonville, Fla., from April 5 to 7, inclusive. There were addresses by both H. C. Clark and John Trix, the presidents of the two associations, and discussions on "Experience with and Benefits to be Derived from Local Organization," "Employment of Salesmen on Commission or Profit-sharing Basis," "Should Manufacturers Pay for Representation in Dealers' Catalogs, and if so, to what Extent?" "Mutual Obligations of Manufacturers and Dealers Under Exclusive Agency Agreements," "Advantages and Practical Results Derived by Adoption of Resale Prices." There was a smoker tendered by the Jacksonville Board of Trade and other entertainments.

Levenus Le Fevre

Levenus Le Fevre, general superintendent of the Nicholson File Works, Paterson, N. J., djed at his home on April 1, aged 56 years.

Mr. Le Fevre entered the employ of this company thirty-six years ago and rose from a bench position to the important place he held at the time of his death.

PERSONALS

Items For This Column Are Solicited

The friends of Fred A. Geier, president of the Cincinnati Milling Machine Company, who was recently operated upon for appendicitis, will be glad to learn that he is now well on the road to recovery.

J. W. Eskholme, who has been connected with the C & C Electric Company for a number of years, has assumed management of the newly established Chicago branch of the Garwood Electric Company.

John B. Mayo, until recently connected with the Crocker-Wheeler Company, Ampere, N. J., has been appointed mechanical engineer and chief draftsman of the Texas Portland Cement Company, Cement, Texas.

Frank R. Heym, formerly superintendent of the Burroughs Adding Machine Company, Detroit, Mich., has recently accepted a position as superintendent of the Waterbury Tool Company, New Britain, Conn.

Louis Booth, who has been employed at the Worcester mill of the American Steel and Wire Company, is the new superintendent at the New Haven plant, succeeding John H. Wheeldon, who returns to the Worcester mill.

E. V. Galen, formerly with the Armstrong Tool Company, Chicago, Ill., has entered the employ of the Matson Machine and Tool Company, Bethel, Vt., and will act as its New England representative with headquarters in Boston, Mass.

S. P. Boushoneff, "Engineer of the Foundry of His Imperial Majesty, the Czar of Russia," arrived in this country April 5. His visit is principally for the purpose of purchasing cotton-gin machinery and supplies for the mills which belong to the Czar personally. It is his intention to travel extensively through the South to get acquainted with new ideas in all lines of the cotton business.

New Tools *and* Machine Shop Appliances
Showing New Ideas *in* Machine Shop Equipment *that* make *it* possible *to* do better work at a reduced cost

ANY new or improved machine or shop appliance of interest to our readers will be illustrated and described in this department.

A full and more detailed description will be given—when of special interest and it appears here before being sent elsewhere.

ALL descriptions appear in all four editions of the paper—Weekly, Monthly, Weekly English and Weekly German.

Landis Cam Grinding Machine and Attachments

The cam-grinding machine of the Landis Tool Company, Waynesboro, Penn., illustrated on page 615, is a complete machine especially designed for this work instead of being an attachment for their regular machines. In addition to this they are making a cam-grinding attachment for their regular machine, which can be very easily used when needed.

All Geared Lathe

The illustration shows one of the new all geared lathes built by the Pond works of the Niles-Bement-Pond Company, which contains several new features. All the gearing in the head has been inclosed and the motor is mounted directly on the head itself with all gearing inclosed in the case shown. The gears at the end of the lathe are also guarded, although these guards were not in place when the photograph was taken.

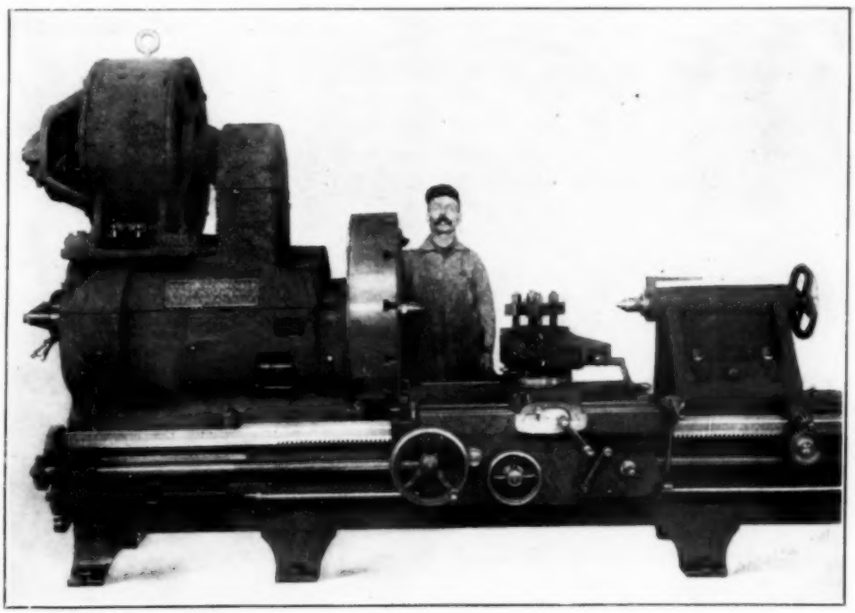


FIG. 1. MOTOR-DRIVEN POND ALL-GEARED LATHE

The quick-change gear mechanism, which gives 32 changes, is contained in the bed and is extremely simple as can be seen in Fig. 2 which is a view looking up under the bed. As will be seen from the two rows of holes in the front of the bed, the tumbler lever is moved both above and below the center line, which is in its neutral position. There are two tumbler gears, the upper one being in-meshed when the tumbler lever is in the upper holes, and the lower one when the lower holes are used. The entire mechanism is very clearly shown by the underneath view and the method of operation needs no explanation.

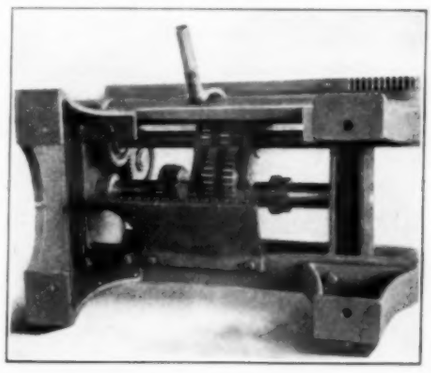


FIG. 2. QUICK-CHANGE FEED DEVICE

These lathes are built in sizes from 36 to 72 inches and are made with a single pulley drive or with a motor mounted as shown.

An Inserted Cutter Boring Tool

The halftones, Figs. 1 and 2, show a tool invented by George Braithwaite and Oscar B. Elder, Chicopee Falls, Mass.

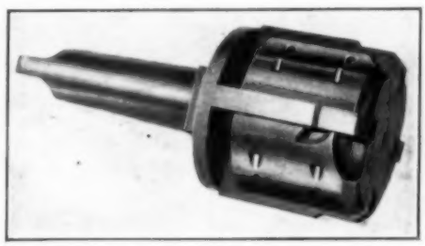


FIG. 1. AN INSERTED-CUTTER BORING TOOL

The body of the tool is made of any suitable material while the blades are made of high-speed steel. The blades are held in the slots by means of pins which are slightly tapered on one side and act as wedges forcing the blades to the bottom of the slot. The elongated holes in the blades allow them to be set forward by the nut at the back.

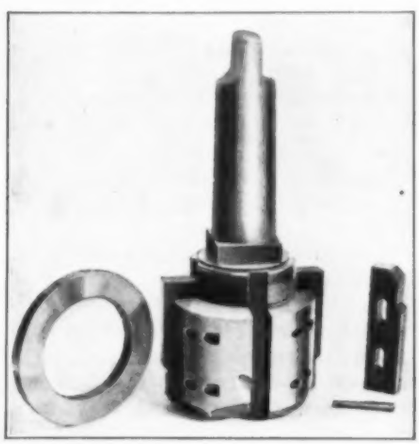


FIG. 2. THE TOOL DISASSEMBLED

The tool is particularly adapted for drilling cored holes ready for reaming. The one shown has been in use in the shops of the Stevens-Duryea Company, Chicopee Falls, Mass., continuously since November 1, 1908, the last job it was used on being the boring of 2500 drop-forged hubs.

Gas Heated Furnaces

The halftones show three of a line of furnaces, using gas as fuel, which have been brought out by the Westmacott Gas Furnace Company, Providence, R. I.

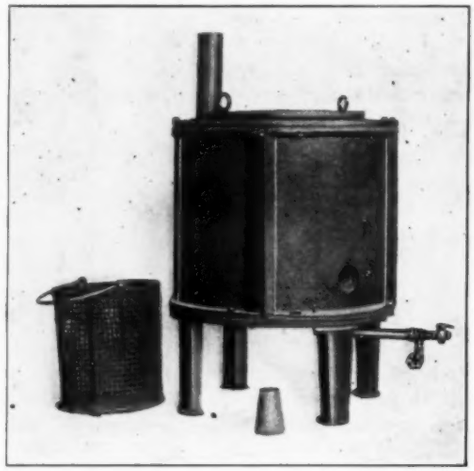
Fig. 1 shows a cylindrical furnace for hardening small tools by the barium-chloride process. One drawback to this process has been the long time required to bring the chloride to the correct temperature for hardening. With this furnace it can be brought to a temperature of 2200 degrees Fahrenheit in about 25 minutes. The crucible is 7½ inches high by about 5¾ inches diameter and will hold about 15 pounds of chloride. The gas consumption for maintaining a temperature of 2200 degrees Fahrenheit is about 130 cubic feet per hour. Air is used at a pressure of 1½ pounds. The furnace occupies a floor space 16 inches square and weighs about 250 pounds. The top of the furnace is at a hight for the operator to work conveniently.

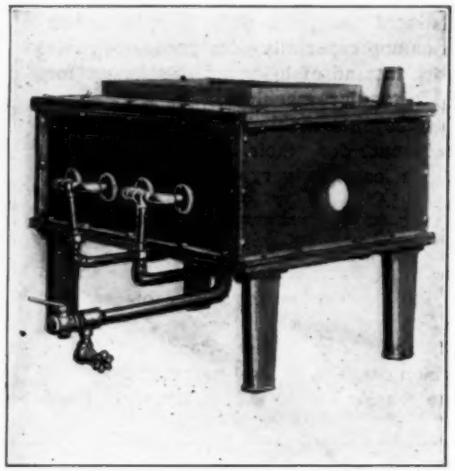
Fig. 2 is an oil-tempering furnace with a pot 17½ inches diameter by 17½ inches deep either of cast iron or steel. The basket is 12 inches diameter by 14 inches deep.

The furnace consumes about 90 cubic feet of gas per hour with air pressure at from ½ to 1 pound. A special thermometer registering to 700 degrees Fahrenheit is supplied at extra cost. The plates of the furnace are fastened only at the top and bottom and are merely lapped between these points, permitting free expansion and contraction. This furnace weighs about 1100 pounds and occupies a floor space 28 inches diameter.

Fig. 3 shows a lead-hardening furnace which has a rectangular pot 20 inches long, 10 inches wide, and 7 inches deep either of cast iron or steel.

One hundred and fifty feet of gas per hour will maintain the lead at a temperature of 1600 degrees Fahrenheit. The air pressure used with this furnace is from 1½ to 2 pounds. The furnace weighs 1300 pounds and occupies a floor space of 20x22 inches.



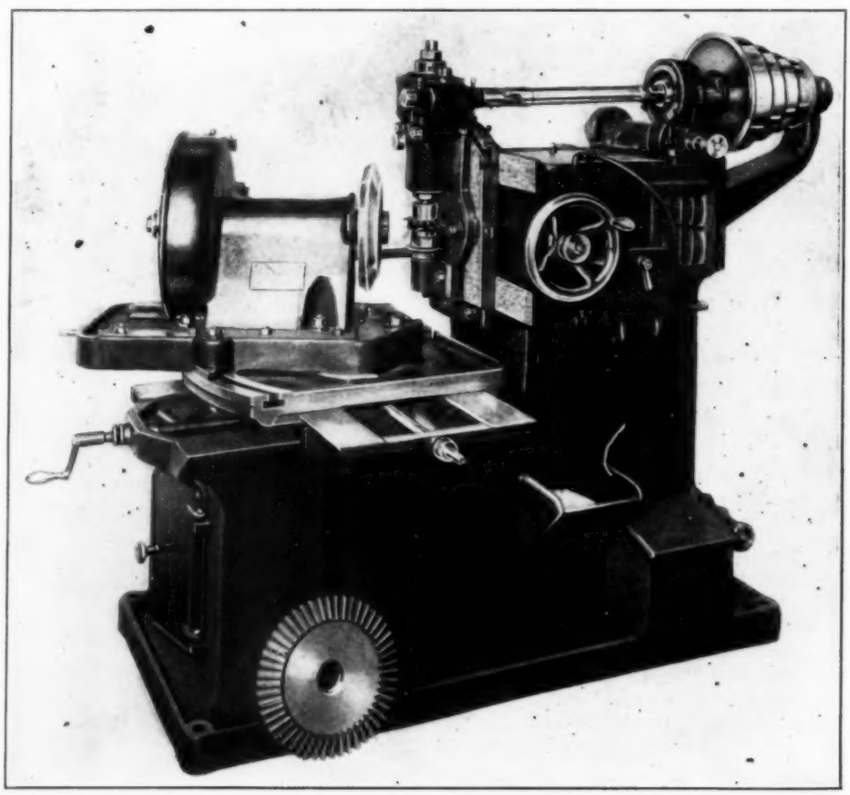


FIGS. 1, 2 AND 3. GAS-HEATED HARDENING AND TEMPERING FURNACES

A New Bevel Gear Blocking Out Machine

The Carpenter & Kerlin Gear and Machine Company, 77 White street, New York City, has placed upon the market a machine for blocking out bevel gears, which is particularly adapted to automobile driving gears. This machine was first exhibited some two years ago at the Automobile Salon in Paris by M. M. Chambon, of Lyons. Since that time it has been greatly modified. A study of the accompanying halftone will illustrate its extreme simplicity; all the working parts are instantly accessible, there is practically nothing to get out of order.

The cutting operation is continuous; one passage across the face completes the gear; there is no indexing and no lost time. The time taken to complete the gear is simply a matter of cutter capacity. The operation of the helicoidal cutter used was described in detail at



CHAMBON BEVEL-GEAR HOBBER

page 319, Volume 30, Part 2, of the AMERICAN MACHINIST.

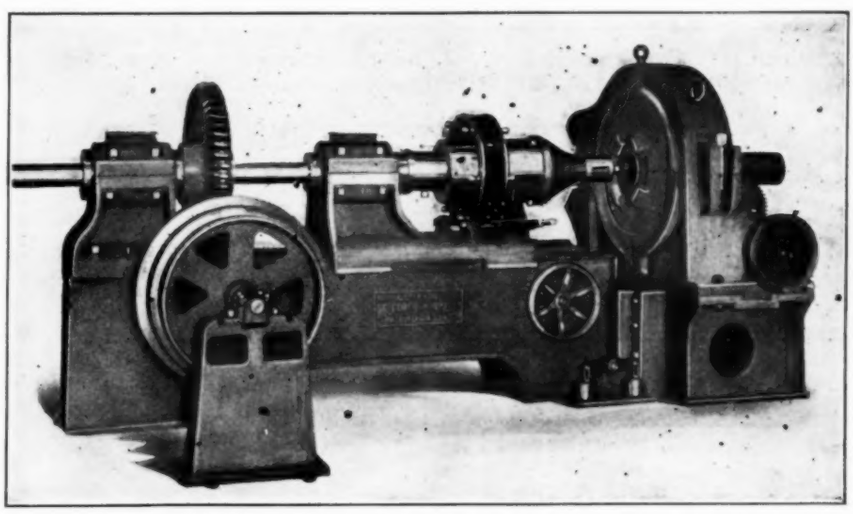
This machine will block and bevel gears from 1⅝ inches to 16 inches in diameter, 3¼-inch face, 3½ diameter pitch in steel. Diameter of index gear, 15 inches. Cutter speeds 40 to 160 revolutions, feeds 0.013 to 0.30 inch per revolution. Speed of countershaft, 650 revolutions. Net weight, 4200 pounds. Equipped with full set of change gears, oil pump indicator and cutter. Power required to operate, two horsepower.

A 60-tooth, 3½ diameter pitch, 1½-face steel gear may be blocked out in 40 minutes, leaving 0.02 inch on each side of the tooth for finish, teeth are cut full depth.

Lovekin Pipe Expanding and Flanging Machine

The increasing practice of using flanged joints in piping, and the preference which is being shown for expanded rather than threaded joints, has led to the extended development of the machine shown herewith. These machines have now been developed to handle all sizes of pipes from 2 inches to 24 inches in diameter, and larger machines will be built on special order. The machine illustrated handles pipes from 6 to 16 inches, weighs 13,000 pounds and occupies a floor space of 10 feet 9 inches by 6 feet 8 inches.

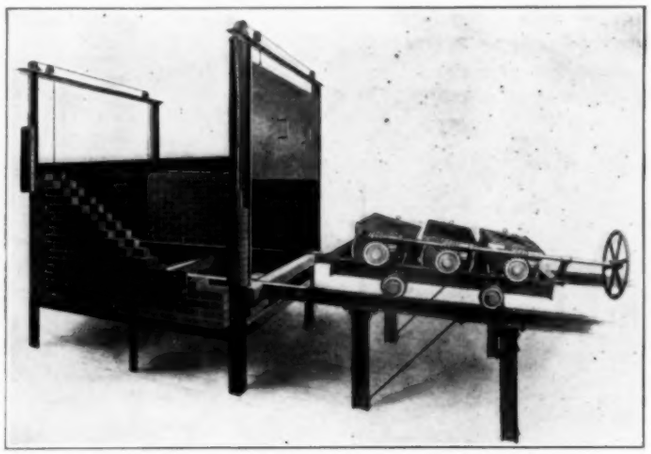
The flanges are provided with internal grooves, into which the pipe is expanded by the rolling tools used, and the outer end of the pipe is also expanded into a beveled or chamfered recess at the face of the flange. The rolling process is claimed to be very much cheaper than the riveting, and to be approximately the same as the threaded flange on sizes from 2 to 7½ inches, the flanging being cheaper on sizes above this. With a flange joint it is possible to use a thinner pipe, than where it is necessary to allow for the metal cut away in threading, which is to be considered in some classes of work. These machines are built by the Lovekin Pipe Expanding and Flanging Machine Company, Philadelphia, Penn.

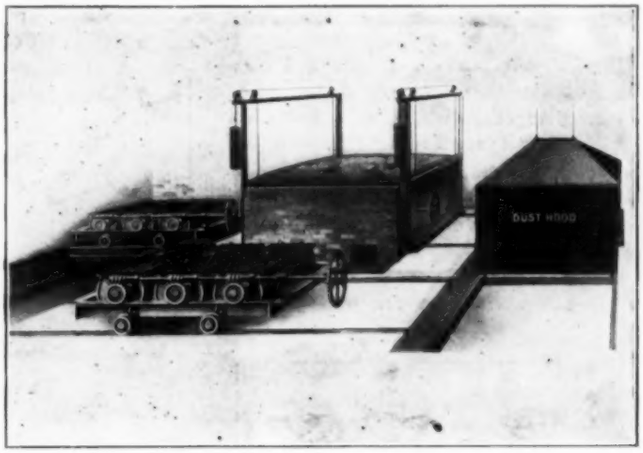


LOVEKIN PIPE-FLANGING MACHINE

Sheradizing Plant

The sheradizing process, or as it is sometimes called the dry galvanizing process, consists of heating the metal pieces to a certain temperature in the presence of zinc dust and soaking them in that heat until the necessary coating of zinc has been given them. To make this process economical, a continuous plant that will reduce the time to a minimum, is a necessary factor.





CONTINUOUS OPERATING SHERADIZING PLANT

For this reason the Globe Machine and Stamping Company, of Cleveland, Ohio, has placed upon the market the apparatus shown in the illustration. With this they have improved the quality and reduced the time for sheradizing to six hours per heat. They are enabled to run four heats per day with but two men working days, providing the watchman is permitted to remove one car from the oven and put another in its place during the middle of the night.

Portable Electric Drill

The Lamb-Electric Company, Grand Rapids, Mich, is building a portable electric drill which is designed to be thoroughly ventilated without the use of a fan. It is easy to inspect as it can be entirely taken apart by loosening two nuts. The only size now made will drill ⅜-inch holes in steel but other sizes are to follow later. They are made for both alternating and direct current, the former being slightly larger and heavier than the latter.

New Hand Milling Machine

The National Machine and Tool Works, Rockford, Ill., are building a hand milling machine mounted on the usual column which has a tool cupboard in the base. It has a removable over arm and is fitted with a vertical milling and slot-

ting attachment, making it very convenient for tool room and similar work. The table has both screw and lever feed. The vertical milling attachment can be readily set for angular cuts.

A Horizontal Drilling and Tapping Machine

The halftone shows a drilling and tapping machine used for finishing hard-rubber syringes, collars, nuts and similar light work. The machine is driven by one pulley, which is secured to the spindle and runs between two loose pulleys smaller in diameter. By pressing on the treadle the two belts are shifted by a simple application of a patented universal belt shifter of the pull to stop

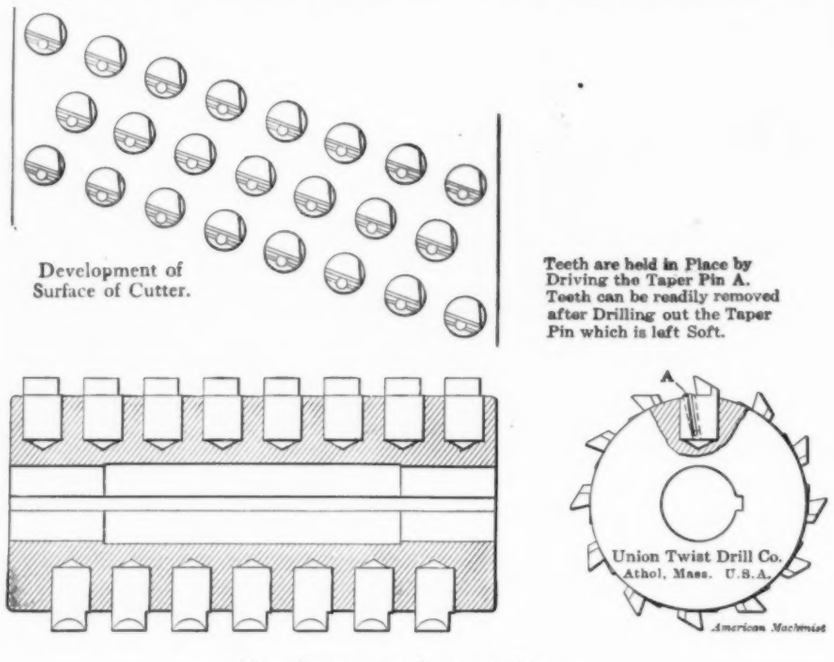
A Horizontal Drilling and Tapping Machine

and pull to start kind, at the same time the belts which reverse the machine are shifted, the brake band tightens on the smooth sleeve of an ordinary drill chuck which causes the chuck to open. The next time the treadle is pressed the spindle runs forward again and the brake band tightens on the sleeve of the chuck, which in turn closes and grips the work. Two belts, one straight and one crossed, are used. The machine has a hollow spindle which has a capacity of ⅞ inch.

On work such as syringes when finished, instead of removing them from chuck they are pushed through and drop out the rear end of the hollow spindle. The turret, carrying one drill and one tap, is automatic, so that each return motion of the hand-operated tail spindle presents first one tool and then the other into locked alinement. The machine is made by the Garvin Machine Company, of New York City, and weighs 445 pounds.

A New Porcupine Milling Cutter

The Union Twist Drill Company, Athol, Mass., have brought out a new milling cutter of the "porcupine" type. The teeth in this cutter are split the greater part of their length that they may be expanded by a taper pin and thus securely held in the steel body. The end view of accompanying cut will illustrate this. The teeth


Development of Surface of Cutter.
Teeth are held in Place by Driving the Taper Pin A. Teeth can be readily removed after Drilling out the Taper Pin which is left Soft.
A
Union Twist Drill Co.
Athol, Mass. U.S.A.
American Machinist

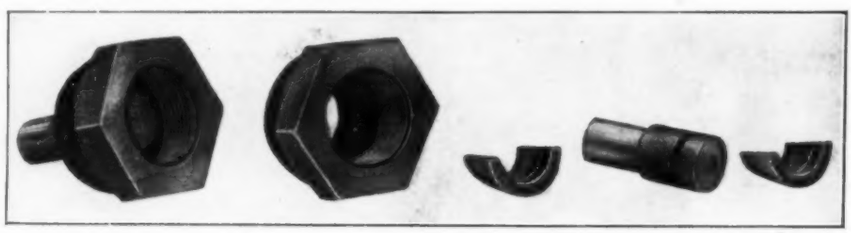
New Porcupine Milling Cutter

are readily removed by drilling out the taper pin, which is left soft.

It is evident that this cutter may be made much smaller in diameter than is possible with the regular cutter of this type. The teeth are securely held, and are cheaper to replace.

A Punch and Holder

The halftone shows a new holder and punch which has been brought out by



A Punch and Holder

the American Die and Tool Company, Reading, Penn. To the left is shown the holder and punch assembled, and to the right are shown the component parts.

The holder screws on to the stub of the punching machine; it is tapered inside at the front end and two tapered half-bushings are provided, which fit this taper. The body of the punch is turned the size of the hole in the bushings and has an annular groove which fits an annular tongue in the half-bushings. The stub of the punching machine bears on the top of the punch, and the two half bushings, and takes all the strain; the half bushes merely center the punch and are not subject to wear. The punch made in this way can be made of smaller stock, and the only part subject to wear can consequently be renewed at little expense.

New 14-inch Engine Lathe

The Robbins Machine Company, Worcester, Mass., has recently placed on the market a new engine lathe possessing some improved features. The lathe is of rigid construction, designed for the use of high-speed steel tools. The gear box is of the sliding gear type and the headstock is made with either three- or four-step cone pulley for a wide belt.

The lathe is also made to swing 16 inches over the ways, and the company builds the same type of machine in 12- and 15-inch sizes.

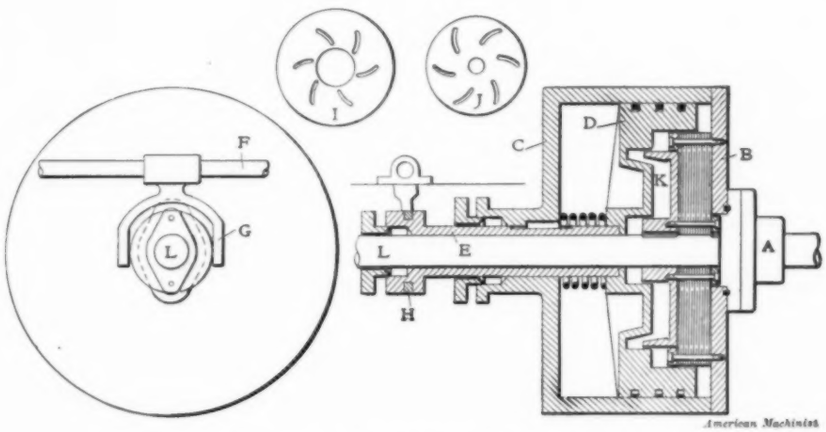
A Fluid Speed Changing Device

The cut illustrates a device for varying the speed between two axially alined shafts and transmitting power from one to the other. The illustration shows a speed controller combined with a positive friction cone clutch, the operation of which may be described as follows:

A is a coupling on a driving shaft secured by bolts to the head *B*, held nonrotatively with respect to the cylinder *C*, in which the piston *D* may be laterally but not rotatively moved with respect to *C* by means of a lever, working in a segment (lever and segment not shown) secured to the shaft *F* operating the forked lever *G*, which transmits motion by means of the collar *H* to the sliding sleeve *E* to which *D* is securely attached. *I* and *J* are very thin metallic disks spaced extremely close to one another, but not making mechanical contact. They are placed alternately, the *I* disks being held nonrotatively with respect to *A*, *B*, *C* and *D*, and the *J* disks being held nonrotatively with respect to the hollow cone head *K*, which is secured nonrotatively with respect to the driven shaft *L*.

The variable speed drive is obtained through the skin friction of a thin film of fluid, preferably castor oil, or some other heavy oil. The variation of speed between driving and driven shafts depends upon the surface contact of the film of oil between the driving and driven disks, which may be controlled by the displacement of the piston *D*. The cut shows the displacement piston *D* when the speed of the shaft *L* is about one-third of the speed of the driven shaft. With the piston *D* at its extreme right position the drive is positive through the friction cone clutch. At the extreme left position of the piston *D* the shaft *L* is idle when the driving members are revolving. Any intermediate speeds may be obtained at any time by adjusting the displacement of the piston *D*.

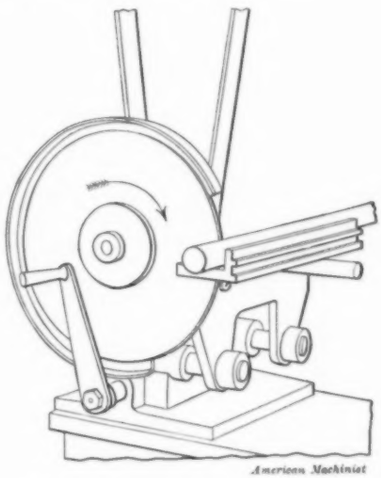
This device is the invention of Robert E. Newcomb, Holyoke, Mass.



A Fluid Speed-changing Device

Bethel Cutting Off Machine

This machine is so designed that the cutting is done at the back, which allows the front to be entirely closed and prevent dust and sparks interfering with the operator in any way. When in use the wheel is completely inclosed, the hood being removed to show the wheel.



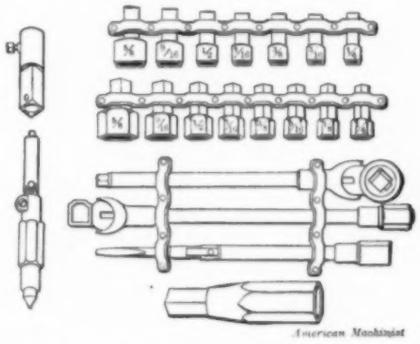
Safety Cutting-off Machine

The stock is fed toward the wheel by the crank at the side and the stock carrier can be adjusted to any angle up to 12 degrees, to allow high-speed steel being cut off with the desired top or side for cutting tools. The wheel is 12 inches in diameter by 3/32 inch thick and is run at about 4000 revolutions per minute which gives between 12,000 and 13,000 feet cutting speed.

It has a capacity up to 1⅛ inch round and will cut off flat blocks up to 3 inches wide. These machines are made either for bench or pedestal as may be desired and are particularly designed for cutting off high-speed steel or tubing of any kind. It is made by the Matson Machine and Tool Company, Bethel, Vermont.

A Combination Set of Wrenches

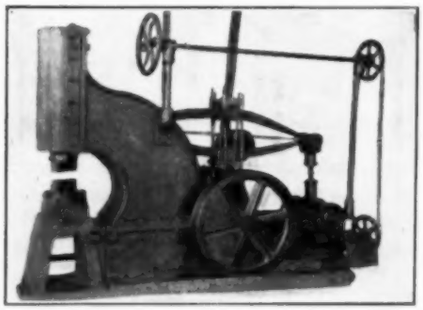
The set of wrenches shown in the line cut is made by the C. M. B. Wrench Company, Syracuse, N. Y. The socket wrenches and universal joints are made of a strong silver-white non-rusting alloy and the connections are made of square section steel tube. With the various combinations nuts and screws can be tightened in the most inaccessible places and the extensions can be so compounded as to give any reasonable amount of leverage. The ratchet head and extension fittings are provided with springs for retaining the various sockets.



A Combination Set of Wrenches

New Power Hammer

Those having interchangeable parts to forge will be interested in the new power hammer illustrated herewith, with which parts can be forged to within very close limits.



New Power Hammer

The dies are set with the handwheel shown on the accompanying halftone, and the stroke can be adjusted for various sizes of work, while the hammer is in motion, by means of the handwheel on the

side, the sprocket and the chain at the rear, and worm gear at the bottom controlling the eccentric shaft which carries the rear connection for the helve.

By the spring helve, and eccentric motion, the force of the weight of the blow of the ram is multiplied and has a degree of elasticity that reduces danger of breakage and at the same time cushions the jar so that none is felt in the working parts of the hammer.

The ram has a long bearing in the guides, which are made in one piece rounded out at the front for clearance, and this gives a strong construction. The anvil block is separate from the bed, and the lower die may be adjusted in any desired direction.

The hammer is a recent product of the New Metal Tool Steel Company, Standish, Maine.

Report of the New York Liability Commission

The first report of the commission appointed to inquire into the question of employers' liability and other matters by the legislature of the State of New York has just been issued. It gives the results of some very exhaustive research into accidents occurring in New York State, showing those which are reported to various State bodies, and also pointing out a large percentage which are not reported in any way, and containing much valuable information for those who are looking into this extremely important industrial problem. The conclusions of the investigators, approved by all but one of the commission appointed, are that:

"First. The present system in New York rests on a basis that is economically unwise and unfair, and that in operation it is wasteful, uncertain and productive of antagonism between workmen and employers.

"Second. That it is satisfactory to none and tolerable only to those employers and workmen who practically disregard the legal rights and obligations and fairly share the burdens and accidents in industries.

"Third. That the evils of the system are most marked in hazardous employment, there the trade risk is high and serious accidents frequent.

"Fourth. That, as a matter of fact, workmen in the dangerous trades do not, and practically cannot, provide for themselves adequate accident insurance, and, therefore, the burden of serious accidents falls on the workmen least able to bear it, and brings many of them and their families to want.

"These results can, we think, be best avoided by compelling the employer to share the accident burden in intrinsically dangerous trades, since by fixing the price of his product, the shock of the accident may be borne by the community. In those employments which have not so great an element of danger, in which, speaking generally, there is no such imperative demand for the exercise of the police power of the State for the safeguarding of its workers from destitution and its consequences, we recommend, as the first step in this change of system, such an amendment of the present law as will do away with some of its unfairness in theory and practice, and increase the workman's chance of recovery under the law. With such changes in the law we couple an elective plan of compensation, which, if generally adopted, will do away with many of the evils of the present system. Its adoption will, we believe, be profitable to both employer and employee, and prove to be the simplest way for the State gradually to change its system of liability without disturbance of industrial conditions.

"Not the least of the motives moving us is the hope that by these means a source of antagonism between employer and employee, pregnant with danger for the State, may be eliminated."

This report is signed by J. Mayhew Wainwright, chairman; Frank B. Platt and Howard R. Bayne, from the Senate; A. D. Lowe, George A. Voss, Frank B. Thorn, Cyrus W. Phillips and Edward D. Jackson, from the Assembly; Henry R. Seager, Otto M. Eidlitz, John Mitchell and Crystal Eastman, appointed by the Governor, as well as Joseph T. Cotton, Jr., counsel for the commission.

Pittsburg Section of the American Institute of Electrical Engineers' Banquet

The second banquet of the Pittsburg Section of the American Institute of Electrical Engineers was held in Pittsburg at the Ft. Pitt Hotel on the evening of Friday, April 8.

Those present were mostly engineers and manufacturers from the Pittsburg territory, although the surrounding districts were well represented.

C. B. Auel, manager of the Railway and Control Division of the Westinghouse Electric and Manufacturing Company, and chairman of the Pittsburg section of the society, acted as toastmaster and introduced as the speakers of the evening, L. B. Stillwell, president American Institute of Electrical Engineers; C. F. Scott, past president A. I. E. E.; M. C. Rorty, traffic manager Central District and Printing Telegraph Company; Dr. Walter Riddle, Sterling Varnish Company; and George C. Johnson, M.D., Pittsburg.

Eugene S. Bristol

Eugene Stuart Bristol, president of the New Haven Manufacturing Company, New Haven, Conn., died on April 2, 1910.

Increasing Shop Capacities

Where More Tools will be needed

Jurgens Bros., Priest River, Idaho, will erect a large sawmill.

English & Butler will erect a shingle mill at Hamilton, Wash.

The Syracuse (N. Y.) Safe Company is to erect a new factory.

The Shawnee (Ohio) Flash Brick Company is to enlarge its plant.

The Winkleman Lumber Company will erect a sawmill at Tacoma, Wash.

The Port Lavaca (Tex.) Broom Company is to erect three new buildings.

The Starr Piano Company, Richmond, Ind., is to build a five-story addition.

The Platt Can Company, Baltimore, Md., will erect a three-story addition.

Authentic news is solicited for this department. Real opportunities for the sale of machinery of any kind.

The Fruit Growers Association, of Eugene, Ore., will erect a canning factory.

Albrecht & Co., Baltimore, Md., bookbinders, will erect a new four-story factory.

The Hall Lace Company, Jersey City, N. J., will build an addition to its plant.

The Monarch Lumber Company, Portland, Ore., will erect a mill at Kenton.

The Lewiston Clarkson Cannery Company will erect a plant at Lewiston, Idaho.

The Gilbert Hunt Company, of Walla Walla, Wash., will enlarge its machine shop.

The Tabor Mill, New Bedford, Mass., is erecting an addition for the installation of 700 looms.

The Spargo Wire Cloth Company, Rome, N. Y., is doubling the capacity of its plant.

The Hampton-Kelley Canning Company, Hampton, Ia., has secured site for a plant.

Albert Regan, of Dayton, Wash., will establish a sawmill on the upper Tukanan river.

The Willapa Boiler Works will move its works from South Bend, Wash., to Raymond.

The Field Force Pump Company, of Elmira Heights, N. Y., will erect a two-story addition.

The Richmond Lace Works, Alton, R. I., is to erect extensions and double its present capacity.

The Shaft-Pierce Shoe Company, of Faribault, Minn., will erect a factory in St. Louis, Mo.

The American Steel Foundries Company has decided to enlarge its plant at Alliance, Ohio.

The Harper Machinery Company is moving its plant from Bloomfield, N. J., to Roselle Park.

Boyes, Hulshizer & Co., Seward, Neb., will construct a hydro-electric plant on the Blue River.

The shingle mill of S. Van Cleeve & Son, at Camano, Wash., was destroyed by fire. Loss, $10,000.

D. & H. Scovil, Inc., Higganum, Conn., manufacturing hoes, will erect a machine shop this summer.

The Corry (Penn.) Metal Furniture Company, recently incorporated, is planning the erection of a factory.

The Bush Terminal, Brooklyn, N. Y., is to erect another six-story building to cost $300,000.

The Parker Buggy Corporation, Franklin, Va., has had plans drawn for a new three-story plant.

The Canton (Ohio) Baking Company will erect a $20,000 addition. New machinery will be installed.

The Ashaway (R. I.) Clay Works is to build additions, increasing the capacity of the plant 40 per cent.

The Lawton Spinning Company, of Woonsocket, R. I., will erect a $350,000 addition to its plant.

The Northwood Furniture Company, Chippewa Falls, Wis., will erect a bolt resaw mill at its plant.

The planing mill of Leland Knott & Co., Cassadaga, N. Y., was destroyed by fire. Loss, about $50,000.

The Lake Shore Railway will spend $100,000 this season in establishing a repair shop at Ashtabula, Ohio.

Fire destroyed the Central Granaries Company's elevator at Holdredge, Neb. Loss, about $300,000.

The Edible Products Company, Bayonne, N. J., is to build an addition and also increase its power plant.

The Standard Oil Company Eagle Works, Caven Point, Jersey City, N. J., will enlarge its power plant.

The Enterprise Brass Foundry Company, Tacoma, Wash., contemplate the installation of an iron foundry.

The city of Lakeland, Fla., is to spend $18,000 in enlarging the electric-light plant and pumping station.

The International and Great Northern Railroad will build boiler shops in San Antonio, Tex., to cost $50,000.

The canning factory of the Texas Company at Port Arthur, Tex., was destroyed by fire. Loss, about $100,000.

Fire destroyed the plant of the Olympia Foundry and Machine Company, Tacoma, Wash. Loss, $150,000.

Fire destroyed the mill at the Grace Ping mine, two miles north of Joplin, Mo., entailing a loss of about $20,000.

The Otto Wissner Piano Company will erect a six-story factory at 55-57 Flatbush avenue, Brooklyn, N. Y.

The W. C. Hendrie Rubber Company, Denver, Colo., has completed plans for the erection of a new building.

The Seaside (Ore.) Lumber and Manufacturing Company will make extensive improvements and enlargements.

The M. U. R. Company has awarded contract for the erection of a large paint and repair shop at Albion, Mich.

The City Council, Tyndall, S. D., is planning the installation of a municipal electric lighting system to cost about $20,000.

Two additions are to be made to the plant of the George W. Blabon Company, at Nicetown, Penn., manufacturing oil cloths.

The Sawyer-Massey Company, Hamilton, Ont., building agricultural machinery, will build an addition to its plant.

The Fraser River Lumber Company, New Westminster, B. C., will erect a sawmill at Millside, to cost $250,000.

The Baker Manufacturing Company, Evansville, Wis., manufacturing windmills, etc., will erect two additional buildings.

The Methodist Hospital, Des Moines, Iowa, will build a new engine and boiler room. Also install an electric-lighting system.

The Gurney Ball Bearing Company, Jamestown, N. Y., is erecting a new factory to replace the one recently destroyed by fire.

The Fort Wayne (Ind.) Rolling Mills is erecting an addition to be used in the manufacture of its twisted concrete bars.

The plant of the T. R. Welsh Manufacturing and Planing Mill Company was destroyed by fire, causing a loss of over $50,000.

The C. A. Woolsey Paint and Color Company, 500 Grand street, Jersey City, N. J., will build an addition to its factory.

The Appel Electric Company, Dayton, Ohio, will erect an addition to its plant. The company manufactures electrical apparatus.

The Columbian Pump and Machine Company, Youngstown, Ohio, is preparing to build an addition which will be used as a machine shop.

The North Jersey Traction Company will erect a one-story building at Hoboken, N. J., to contain power plant and car barn.

The Wilmot Engineering Company, of Hazleton, Penn., has leased the building in Hazleton formerly occupied by the Harleigh Iron Works.

The Hayes Pump and Planter Company, Galena, Ill., is having plans prepared for additions to its plant, including gray-iron foundry.

The Winters-Coleman Scale Company, Springfield, Ohio, has secured a larger plant for its business, having outgrown the present quarters.

The Atlas Chain Company, making automobile tire chains, will locate in the Bush Terminal building, 39th street, South Brooklyn, N. Y.

The Thames Dye and Bleachery Company, Montville, Conn., has awarded a contract for the erection of a plant. Austin J. Perry is president.

The Coffer Shingle Mill, at Mount Lehman, 10 miles from South Prairie, Wash., was destroyed by fire. Loss, $25,000. Will be rebuilt.

The Cribben & Sexton Company, Chicago, Ill., manufacturing stoves, has awarded contract for the erection of a new factory building.

L. Barber and W. R. Oxley are in charge of the Cheney, Simons & Ray mine at Gold Hill, Ore., where a 40-stamp mill will be installed.

O. S. Walker & Co. and Walker Grinding Company, Worcester, Mass., have awarded the contract for the construction of a new plant at Greendale.

The McDougal Manufacturing Company, whose furniture factory at Indianapolis, Ind., burned sometime ago, will rebuild in Frankfort, Ind.

The Eclipse Mining Company has purchased the property of the Copper Independent at Silverton, Wash., and will install power drills and hoist.

The Raymond Manufacturing Company, Corry, Penn., is building an addition which will double its capacity. The company manufactures springs of all kinds.

It is announced that the mill at the Monarch mine at Murray, Idaho, will soon be increased to 250 tons capacity. E. P. Spaulding, manager.

Contract has been awarded for the erection of a two-story addition to the cabinet factory of the Victor Talking Machine Company, Camden, N. J.

A large warehouse is being erected at Irvington, N. J., by W. L. Glorieux, which when completed will be leased to the Washburn-Crosby Company, of Buffalo, N. Y.

The Southington (Conn.) Manufacturing Company have opened a factory for making builders' hardware. M. Mohr, manager and superintendent.

The Republic Rubber Company, Youngstown, Ohio, has commenced the erection of a new building to be used for the manufacture of rubber novelties.

The Burrows Lock, Nut and Bolt Company, of Boston, Mass., has purchased ground at West Gloucester, and plans the erection of a factory there.

The cold-storage plant, warehouse and wharf of the Crowell Cold Storage Company, at East Dennis, Mass., were destroyed by fire. Loss, about $25,000.

Stearns & Castor have prepared the plans for a new garage to be built at 23d and Market streets, Philadelphia, for the Auto Car Company. This is to cost about $100,000.

The Galloway-West Company, Fond du Lac, Wis., which recently took over the plant of the Fond du Lac Cold Storage Company, is to erect a $5000 addition.

The Central Mortar and Supply Company, Columbus, Ohio, will erect a plant at Second avenue and the Big Four Railroad tracks for the manufacture of mortars.

F. W. Dewart, of Spokane, Wash., and others, have purchased land near Wenatchie, on the Columbia river, and will install a pumping plant for irrigating.

The Roselle Manufacturing Company has purchased a plot of about three acres in Roselle Park, N. J., for the purpose of erecting a plant for extracting by-products from oils.

The Nabob Mining Company, of Wardner, Idaho, expect to install an air compressor and other machinery; also expect to erect concentrator to cost about $20,000.

The Warwick Iron and Steel Company, Pottstown, Penn., has purchased land near its present plant, and it is said, contemplates the erection of a new steel plant.

The Howard Demountable Rim Company, Trenton, N. J., has had plans prepared for a new three-story factory building and one-story brick boiler and forge house.

The Farmers Fertilizer Company, Columbus, Ohio, organized with $200,000 capital, is to erect a fertilizer plant at Winsor and Third avenues. N. B. Huddleson, president.

The Maryland & Pennsylvania Terminal Railway Company has started the erection of a new roundhouse and shops on Falls road, near Twenty-sixth street, Baltimore, Md.

The Boston & Maine Railway Company will probably issue a list of tools required for new

repair shops at Somerville, Mass., in the near future, as this is now nearing completion.

A $240,000 engineering building will soon be started at the University of Cincinnati. Equipment will be of the best, including testing machines and complete machine shop.

The Biddle & Smart Company, Amesbury, Mass., expect to build a new brick stack and install a 100-horsepower boiler and 100-kilowatt steam turbine; also a vacuum heating system.

The Hedden Iron Construction Company has purchased land at West Elizabeth, N. J., for the purpose of erecting a fabricating plant similar to the Watson-Stillman Company at Aldine, N. J.

It is said that plans are being considered for the erection of a large steel plant and foundry for the erection of cars at the railroad yards of the Harriman lines in Ogden, Utah.

The B. F. Goodrich Company, Akron, Ohio, is receiving estimates on a new building to be used as a machine shop, making machinery for the manufacture of tires and other goods.

L. F. Neuweiler & Son, brewers, of Allentown, Penn., have acquired a large plot of ground in Allentown for the purpose of erecting a new brewery with a capacity of 100,000 barrels per annum.

The Northern Ohio Traction and Light Company is planning to construct a 7500-horsepower plant at Akron, Ohio, to take the place of the five plants now scattered through Ohio.

The J. B. Dixon Crucible Company has purchased ten lots between Wayne and Mercer streets, Jersey City, N. J., for the purpose of erecting a large new plant which will cover the entire ten lots.

The Wauchula (Fla.) Manufacturing Company, which is said to be the largest crate-manufacturing concern in the South, is preparing to double its present capacity and will add a barrel factory.

The Boston (Mass.) Elevated Railway Company has issued a list of machine-tool requirements, including engine lathes, flat turret lathes, drill press, grinders, bolt cutters, wood trimmers, etc.

The Amesbury (Mass.) Electric Light Company expect to add a new steam turbine, generators, transformers, boiler feed pump, feed water heater, boiler, oiling system, etc., improvements to cost about $24,000.

The White Pine Sash Company has commenced the erection of a factory on Myrtle street and the Northern Pacific tracks, Spokane, Wash., for the manufacture of sash, frames, moldings, etc.

The Salisbury Wheel and Manufacturing Company, Jamestown, N. Y., manufacturing automobile wheels and axles, has increased its capital stock and expect to build additions to more than double its output.

The Fechheimer Steel and Iron Company, 2 Rector street, New York, has leased a plot of about three acres of land at Allentown, Penn., from the Lehigh Valley Railroad, for the purpose of a scrap iron yard.

The American Saw Mill Machinery Company, Hackettstown, N. J., is preparing plans for an addition to its factory. The company is also said to be considering the erection of a branch factory in Canada.

The Traction Materials Company, R. W. Marshall, general manager, 50 Church street, New York, has purchased a large plot of ground at Cranford, N. J., for the purpose of erecting thereon a new plant, with railroad siding, etc.

The Gregg Company, Ltd., of Newburgh, N. Y., has bought site in Lodi, N. J., on which a $500,000 plant is to be erected. The company manufactures sugar-refining equipment. Plant will employ about 500 men.

The Goodyear Tire and Rubber Company, Akron, Ohio, which is now putting up a five-story addition for the manufacture of tires, is to erect another one-story building and a new power plant of double the present capacity.

The Espen-Lucas Machine Works, Philadelphia, Penn., has purchased a new factory building to which the present equipment will be moved. The new factory will enable the company to more than double its present capacity.

The Thames River Specialties Company, Montville, Conn., has completed an organization with $750,000 capital. A plant is now being erected for the manufacture of special brands of paper. Horatius Bigelow, of Norwich, Conn., is president.

The machine shop and other buildings of the Nicetown Plate Washer Company, Philadelphia, Penn., were damaged by fire, causing a loss of about $15,000. Rolling mill was not damaged, but equipment for machine shop will largely have to be replaced.

The Tuttle Motor Company, Canastota, N. Y., which has been incorporated to take over the business of the D. M. Tuttle Company, is to erect a new foundry and machine shop for the manufacture of gasolene engines. New machinery will be required.

The Schroeder Headlight Company, Evansville, Ind., contemplate the erection of a machine shop in which they expect to install the ordinary shop equipment, consisting of six or eight lathes, several shapers, several drill presses, milling machine, turret lathe and tool room.

Chas. W. Schneider and John C. Schneider, contractors, Columbus, Ohio, have purchased the plant of the Dow Brick Company, and will start operations in the near future. New machinery will be installed, especially apparatus for making hollow brick.

The Willard-Harlow Company, Janesville, Wis., has had plans drawn for a proposed factory. The company will manufacture automobile tops, boat canopies, steam-heat meters, spark plugs, while extensive screw-machine work will be done in the machine shop.

The American Paper Company, Wichita, Kan., with a capital of $500,000, has applied for a charter and will erect a large strawboard and paper mill. Site has been secured on Athenian avenue, and plans for building are now completed. Eugene A. Kelley is president and general manager.

The Niagara Machine and Tool Company, Buffalo, N. Y., is having plans prepared for a new plant to be erected on land recently acquired, which will include modern machine and erecting shop, stores building and office building. As soon as these are completed and occupied the company expects to erect additional buildings. Dodge & Day, Philadelphia, are engineers.

The Navy Department, Bureau of Supplies and Accounts, Washington, D. C., will open the following bids: April 19—Chipping hammers, pneumatic drilling machines (schedule 2377), motor-driven engine lathe (schedule 2367), nickel-steel forgings (schedule 2376), sheet copper (schedule 2379), pig iron (schedule 2378), brass pipe and tubing (schedule 2376), copper tubing (schedule 2379); April 26—Metal furniture (schedule 2365), accumulator, air-compressor outfit, air locomotive (schedule 2370); May 3—Metal clothes lockers (scifedule 2371), steel nuts (schedule 2372, galvanized steel, electrical supplies (schedule 2369) seamless-drawn brass tubing (schedule 2372).

NEW INCORPORATIONS

Muncie Gear Works, Muncie, Ind. Capital, $250,000. Directors, H. L. Warner, D. O. Skillen, G. H. Guthrie, etc.

Richmond Motor Company, Richmond, Va. Garage and transfer business. Capital, $15,000. S. W. Meek, president.

Ocean Garage Company, Freehold, N. J. Capital, $10,000. Incorporators, Geo. N. Duffy, H. F. Weeks, Chas. F. Mount.

Preston Leather Company, Newark, N. J. Manufacture leather goods. Capital, $100,000. Incorporators, Thos. F. Preston, Jas. L. Mason, John Nieder.

Woodville Garage Company, Woodville, O. Operate garage. Capital, $10,000. Incorporators, Fred H. Hartman, W. H. Price, C. A. Kuhlman, etc.

Woodburn Automobile Company, Shirley, Ind. Build and repair automobiles. Capital, $50,000. Incorporators, George Stenger, W. T. Keller, Herman Nussmann.

Phillips Tile and Mantel Company, Columbus, Ohio. Manufacture mantels, fancy tile, etc. Capital, $10,000. Incorporators, D. E. Phillips, L. A. Phillips, etc.

American Electric Protective Company, New York. Manufacture electric alarm systems. Capital, $50,000. Incorporators, B. Webb, M. Schlansky, H. A. Goldner.

Edward Manufacturing Company, Cleveland, Ohio. Manufacture all kinds of tools and factory equipment. Capital, $10,000. Incorporators, E. B. Southwick, E. A. Williams, J. W. Smith, etc.

George B. Lupher Company, Columbus, Ohio. Manufacture mattresses, bed springs, beds, furniture, etc. Capital, $100,000. Incorporators, Geo. B. Lupher, R. H. Beam, M. N. Carpenter, etc.

Federal Railway Equipment Company, New York. Manufacture and deal in railway supplies, equipment, etc. Capital, $500,000. Incorporators, J. N. Drake, New York; R. C. Swan, J. W. Fowler, Brooklyn.

The D. A. Ebinger Sanitary Manufacturing Company, Columbus, Ohio. Manufacture and install plumbing and make plumbing supplies. Capital, $100,000. Incorporators, Donald A. Ebinger, Frank H. Field, D. D. McClellan, etc.

Fry Manufacturing Company, Syracuse, N. Y. Manufacture and deal in machinery, tools and appliances. Capital, $100,000. Incorporators, S. J. Cox, Cranford, N. J.; S. S. Newton, New York; A. C. McDonnell, Bay Ridge, L. I.

The Buckhannon & Clarksburg Electric Railway Company, Buckhannon, W. Va. Build an electric railroad from Buckhannon to Clarksburg. Capital, $250,000. Incorporators, E. W. Martin, G. O. Young, R. I. Perine, and others, of Buckhannon.

The Hardy Manufacturing Company, Pittsburg, Penn. Manufacture and deal in machinery and tools. Capital, $20,000. Incorporators, Jas. B. McGunley, Joseph Enders, of Pittsburg; S. B. Hardy, of Sewickley, Penn.; W. L. Ferguson, of Avalon, Penn.

American Taximeter Company, New York. Manufacture and deal in materials for electrical engineers, toolmakers, metal workers, etc. Capital, $200,000. Incorporators, V. C. King, 27 Pine street; J. A. Straussman, 454 West One Hundred Fifty-second street, etc.

Erlandsen & Wilcox Manufacturing Company, Jamaica, N. Y. Manufacture and deal in hardware, machines, tools, etc. Capital, $10,000. Incorporators, Oscar Erlandsen, 49 Union avenue, Jamaica; Wm. L. Hellahan, 1181 Tinton avenue, New York; P. W. Wilcox, 41 West Fifty-second street, New York.

BUSINESS ITEMS

The Wade Machine Company, of Boston, owing to the rapid increase in its business, has been compelled to move from Oliver street to larger quarters at 287 Atlantic avenue, and has doubled its capacity. It will continue to make dies of all kinds, making a specialty of dies for drop-forging work, also jigs, fixtures and models.

TRADE CATALOGS

Quride Company, 1417 North Salina street, Syracuse, N. Y. Catalog of Quride gears. Illustrated, 24 pages, 3½x6 inches, paper.

The Euclid Crane and Hoist Company, Euclid, Ohio. Catalog describing cranes and hoists. Illustrated, 16 pages, 6x9½ inches, paper.

Pawling & Harnischfeger Company, Milwaukee, Wis. Bulletin No. 17, illustrating and describing I-beam trolleys and chain-block traveling cranes. 6x9 inches, 10 pages.

Joseph T. Ryerson & Son. Technical Library No. 10, describing tool steel. Illustrated, 64 pages, 4½x7½ inches. Technical Library No. 13, describing Glyco metal. Illustrated, 80 pages, 4½x7½ inches.

Lovekin Pipe Expanding and Flanging Machine Company, 421 Chestnut street, Philadelphia, Penn. Catalog describing Lovekin pipe-expanding and flanging machinery. Illustrated, 24 pages, 7x10 inches, paper.

Fort Wayne Electric Works, Fort Wayne, Ind. Bulletin No. 1118, illustrating and describing Type A transformer. Twelve pages, 8x10½ inches. Bulletin No. 1119, illustrating and describing Northern type B direct-current motors. Four pages, 8x10½ inches.

Western Electric Company, 463 West street, New York. Bulletin No. 5132-1, illustrating and describing Hawthorn type EC belt-driven generators. Eight pages, 8x11 inches. Bulletin No. 5360, illustrating and describing Hawthorn small power motors. Eight pages, 8x11 inches.

FORTHCOMING MEETINGS

National Metal Trades Association, annual convention, Hotel Astor, New York City, April 13-14, 1910. Robert Wuest, Commissioner, New England building, Cleveland, Ohio.

International Railway General Foremen's Association, annual convention, May 3-7, Grand hotel, Cincinnati, Ohio. L. H. Bryan, secretary, Two Harbors, Minn.

National Association of Manufacturers, annual meeting, Waldorf-Astoria hotel, May 16, 17 and 18, 1910. Geo. S. Boudinot, secretary, 170 Broadway, New York City.

National Machine Tool Builders' Association, spring convention, May 24-25, Rochester, N. Y. P. E. Montanus, Springfield, Ohio, secretary.

American Society of Mechanical Engineers, spring meetings, Atlantic City, N. J., May 31-June 3. Calvin W. Rice, secretary, 29 West Thirty-ninth street, New York City.

American Foundrymen's Association and American Brass Founders Association; joint convention, June 7-8-9, Detroit, Mich.; headquarters, Hotel Pontchartrain. Richard Moldenke, secretary, Watchung, N. J.

National Gas and Gasolene Engine Trades Association. Semi-annual convention, Cincinnati, Ohio, June 13-16, 1910; headquarters, Hotel Sinton. Albert Stritmatter, secretary, Cincinnati, Ohio.

Master Car Builders Association; annual meeting June 15-17, Atlantic City, N. J. J. W. Taylor, secretary, Old Colony building, Chicago, Ill.

American Railway Master Mechanics Association, June 20-22, Atlantic City, N. J. J. W. Taylor, secretary, Old Colony building, Chicago, Ill.

Joint meeting of American Society of Mechanical Engineers and Institution of Mechanical Engineers, Birmingham, England, July 26-29, 1910.

American Society of Mechanical Engineers; monthly meeting second Tuesday. Calvin W. Rice, secretary, 29 West Thirty-ninth street, New York City.

Boston Branch National Metal Trades Association. Monthly meeting on first Wednesday of each month, Young's hotel. D. F. P. Clark, secretary, 309 Milk street, Boston, Mass.

Providence Association of Mechanical Engineers. Monthly meeting fourth Tuesday each month. E. C. Bliss, president, 91 Sabine street, Providence, R. I.

New England Foundrymen's Association; regular meeting second Wednesday of each month, Exchange Club, Boston, Mass. Fred F. Stockwell, 205 Broadway, Cambridgeport, Mass.

Engineers' Society of Western Pennsylvania; monthly meeting third Tuesday. Elmer K. Hiles, secretary, Fulton building, Pittsburg, Penn.

Superintendents' and Foremen's Club of Cleveland; monthly meeting third Saturday. Phil. Frankel, secretary, 310 New England building, Cleveland, O.

Western Society of Engineers, Chicago, Ill. Regular meeting first Wednesday evening of each month, excepting July and August. Secretary, J. H. Warder, 1735 Monadnock block, Chicago, Ill.

WANT ADVERTISEMENTS

Rate 25 cents per line for each insertion. About six words make a line. No advertisements abbreviated. Copy should be sent to reach us not later than Friday for ensuing week's issue. Answers addressed to our care will be forwarded. Applicants may specify names to which their replies are not to be forwarded, but replies will not be returned. If not forwarded, they will be destroyed without notice. No information given by us regarding any advertiser using box number. Original letters of recommendations or other papers of value should not be inclosed to unknown correspondents. Only bona-fide advertisements inserted under this heading. No advertising accepted from any agency, association or individual charging a fee for "registration," or a commission on wages of successful applicants for situations.

Miscellaneous Wants

Caliper catalog free. E.G. Smith, Columbia, Pa.

We buy or pay royalty for good patented machine or tool. Box 282, AMER. MACHINIST.

Light, fine machinery to order; models and electrical work specialty. E. O. Chase, Newark, N. J.

Work by well equipped shop expert on automobile and marine engine practice. Box 3064, Bridgeport, Conn.

Special machinery accurately built. Screw machine or turret lathe work solicited. Robert J. Emory & Co., Newark, N. J.

Patented specialty wanted in line of heavy machinery. Schaeffer Machine Works, 35th & Gray's Ferry Road, Philadelphia, Pa.

Light and medium weight machinery and duplicate parts built to order; tools, jigs, etc. MacCordy Mfg. Co., Amsterdam, N. Y.

Oilstone holder, described on page 661, mailed for 25c.; shop agents wanted. F. J. Badge, 286 Taaffe Place, Brooklyn, N. Y.

Patents. C. L. Parker, Patent Attorney, ex-examiner Patent Office, 900 G St., Washington, D. C. Write for Inventor's Handbook.

Light and medium weight machinery built; tools, dies, etc.; experimental work for inventors. Universal Patents Mfg. Co., 25 Wright St., Newark, N. J.

Foundry with first-class machine shop and exceptional facilities desires to contract for manufacturing machines or devices of gray iron. Box 419, AMERICAN MACHINIST.

A well equipped machine shop within 30 miles from New York solicits orders for all kinds of machine work. Send inquiries: The Brunswick Refrigerating Co., New Brunswick, N. J.

A large English firm of machine-tool importers having showrooms and offices in Great Britain, France, Italy and Japan, is wanting good agencies for machine tools of all kinds. Apply Box 189, AMERICAN MACHINIST.

Dies and press tools for sheet-metal formation designed and constructed in a modern shop, under personal supervision of the best die man in this country. For dies, presses and anything in sheet-metal formation write to Joseph V. Woodworth, Mgr. Harwood Mfg. Co., 42 South 8th Street, Brooklyn, N. Y.

Firm of engineers, with good central office, shortly opening showroom in Glasgow and having first-class connection throughout Scotland in the engineering trade, desire good agencies for machine tools of all kinds. Reply, stating terms, etc., to Box A.A.6, AMERICAN MACHINIST, 6 Bouverie St., London, E. C.

Help Wanted

Classification indicates present address of advertiser, nothing else.

CANADA

Mechanical superintendent to take charge of large machine shop; apply, stating experience and salary expected. Box 400, AM. MA.

Wanted—First-class toolmakers, particularly on punches and dies, steady work; wages from 35c. to 45c. an hour. Apply Canadian General Electric Co., Ltd., Petersboro, Ont.

CONNECTICUT

Wanted—Experienced mechanical draftsmen for detail work, in a concern manufacturing general rolling mill and hydraulic machinery; state age, experience and salary expected. Box 366, AMERICAN MACHINIST.

Wanted—An A-1 Acme automatic screw machine man; one who can supervise, lay out and design his own tools, etc., and one who can get maximum production on high "quality work;" every condition the best; this opening is made by plant doubling its screw machine equipment, all new machines. Box 362, AMERICAN MACHINIST.

ILLINOIS

Wanted—First-class draftsman, experienced on automatic machinery; give age, experience, education and salary expected. Box 406, AMERICAN MACHINIST.

The board of education of Chicago require teachers in the following departments: (a) blacksmithing; (b) foundry; (c) machine shop; (d) woodworking; (e) electrical construction; (f) mechanical drawing; minimum requirements: The equivalent of a high school education and three years' work in his line; examinations, June 27-28, 1910. For blanks and further information, apply to the Department of Examinations, 829 Tribune Bldg., Chicago.

MASSACHUSETTS

Wanted — First-class draftsman to take charge of drawng room of large plant for manufacturing machine tools, milling machines a specialty; must be experienced. Box 401, AMERICAN MACHINIST.

Wanted—An A-1 salesman who can show results to represent a young growing concern manufacturing a high grade machine tool; also a representative for greater New York. Box 421, AMERICAN MACHINIST.

Wanted—Competent, experienced mechanical draftsman and designer on steam turbine and electrical work, for permanent position with large manufacturing concern in Massachusetts; State age, education, experience and salary expected by addressing A. H. B., Box 408, AM. M.

Wanted—Young men with mechanical ability; experienced machinists and toolmakers, automatic and hand turret machine operators, Cleveland automatic screw machine operator experienced on forming work, carpenter for general repair work, young man patternmaker's assistant; for day and night work, in up-to-date factory with all conveniences in a beautiful suburb, six miles from Boston; night gang Monday to Friday, inclusive. Boston Gear Works, Norfolk Downs, Mass.

MICHIGAN

Wanted—Toolmakers, die sinkers, lathe hands, machinists and automatic screw machine operators; A-1 men only. Buick Motor Co., Flint, Mich.

Wanted—Machinists in Detroit; good machine and floor hands for medium and heavy work; good steady job with responsible concern to good men; state experience and references. Address Box 582, Detroit, Michigan.

Wanted—One of the oldest and best established companies in the Middle West seek the services of a general foreman for their machine shop; about 350 are employed in the department, and building and equipment are thoroughly modern; the nature of the work varies from a line similar to automobiles and manufactured in large quantities, to a medium heavy plain class of railway equipment; none but high grade men apply, as the position is an important one and requires a man of broad experience. Box 415, AM. MACH.

NEW JERSEY

Wanted—Draftsmen familiar with heavy turret lathe work; give references and salary expected. Box 216, AMERICAN MACHINIST.

Toolmakers wanted, conversant with subpress die work for small duplicate parts; factory located in Newark, N. J.; men who have worked on watch dies preferred. Box 385, AMERICAN MACHINIST.

Wanted—A good man on commission to solicit work in the line of general machine repairing, secure orders for building light machinery, tools, dies, etc., and all kinds of experimental work. Box 403, AMER. MACH.

Wanted—By a large manufacturing concern, uptodate foreman with experience and executive ability; first-class opening for right man; state age, experience and salary expected. Box 413, AMERICAN MACHINIST.

Wanted—Machinists; steady work for good milling, boring, lathe and floor hands; also tool and die makers; call in person if possible; cheap rents and pleasant surroundings. Ferracute Machine Company, Bridgeton, N. J. (40 miles south of Philadelphia).

NEW YORK

Wanted—First-class planer hand at once. Address Mosher Water Tube Boiler Company, Ossining-on-Hudson, N. Y.

Wanted—First-class machinist to run Acme automatic screw machines; state experience in full and give references. Box 409, AM. MA.

Toolmakers wanted, experienced on fine jig and fixture work; give age, experience in detail and wages expected. Remington Arms Company, Ilion, N. Y.

Wanted—Foreman for lathe department on auto transmissions; also lathe hands, Jones & Lamson and Gisholt operators; right wages for first-class men; no labor troubles. Box 416, AMERICAN MACHINIST.

Wanted—Toolmakers on model and experimental special automatic machine work; good pay and steady work to competent men. Apply to S. S. White Dental Mfg. Co., Princes Bay, S. I., New York.

Wanted—First-class toolmakers for punch, die and jig work; steady employment and good wages to the right men; state experience, age and wages expected. Salisbury Wheel and Mfg. Co., Jamestown, N. Y.

Wanted—A-1 machinists, familiar with small accurate machine work on lathes, planers and shapers; good wages and steady work to the right men; 55 hours a week. S. S. White Dental Mfg. Co., Prince's Bay, S. I.

Wanted—Screw machine foreman, must be aggressive and used to quick set-ups; job consists of Brown & Sharpe and Gridley automatics and 15 to 18 hand machines; position steady, salary liberal. Box 342, AM. MACH.

Wanted—A machinist and first-class handy all-around man for repair work in a cereal mill to do repair work of all kinds and some work in machine shop; wages $3 per day, time and a half for overtime and Sunday work; steady work the year around. Box 411, AM. M.

Wanted—Assistant foreman, thoroughly experienced in gears, to take charge of gear department, in large works in New York City suburb, cutting large bronze spiral and worm gears; applicants must state experience, age and salary expected. Box 368, AMER. MACH.

Wanted—Assistant foreman for a drilling department on a line of accurate, interchangeable work. When replying, state fully, past experience, names of firms by whom employed, in what capacity, age and wages wanted; no attention will be given to applications that do not contain this information. Box 382, AMERICAN MACHINIST.

Experimental engineer wanted by large manufacturing concern having technical and practical knowledge of mechanics and preferably chemistry as well; must possess special aptitude for this character of work. Address in confidence with full particulars, including salary expected. Business Service Co., 305 Broadway, New York.

Wanted—Assistant foreman for a hand screw machine department on a line of first-class automobile work; we want a man who can produce work rapidly and accurately and who understands piece work. When replying, state where employed for the past five years, in what capacity and wages desired. "Accurate," AMERICAN MACHINIST.

Wanted—We are constantly increasing our force and invite applications from the following: Machinists, lathe hands, screw machine hands, grinder hands, milling machine hands, motor assemblers, toolmakers, sheet metal die men; we run a nine-hour shop, have desirable surroundings, and offer steady position to desirable characters. Address Superintendent, Maxwell-Briscoe Motor Co., Tarrytown, N. Y.

Wanted — Practical draftsman, engines, pumps, general machinery, special tools for shop use, estimating, making up bills materials, requisitions, inspection, etc.; a capable man that has worked his way up through the shops, but well posted in theory and best practice preferred; state experience; give reference, present employer and salary desired, age. Apply to Edgar Penney, V. P., Newburgh, N. Y.

Wanted—Night foreman for milling machine department, doing high-class automobile work; we want a man who can produce accurate work, on a manufacturing basis; must understand piece work and rate setting; when applying, give age, experience, where employed for past six years, in what capacity, and salary expected; this information must be on application or applicant will not be considered. Box 383, AMERICAN MACHINIST.

OHIO

Competent lathe and vise hands by the American Tool Works Co., Cincinnati, O.

Wanted—Draftsman, familiar with detail crane design; state wages desired. The Toledo-Massillon Bridge Co., Toledo, O.

Wanted—First-class lathe, boring mill, shaper and planer hands; inquire at once. The Heisler Company, St. Marys, Ohio.

Wanted—A hustling general superintendent for a small electrical plant manufacturing electric vacuum cleaners; a good salary and an excellent opportunity for advancement is offered to a competent, general superintendent; must be a hustler, able to get work through the shop and a good organizer. Applications will only be considered from competent, experienced man. Address "Cleaner," Box 410, AMERICAN MACHINIST.

Wanted—First-class machinists, toolmakers die sinkers, lathe, planer, drill press, screw machine, boring and milling machine operators, wood patternmakers, brass molders, polishers, buffers, finishers, spinners, millwrights, hammermen and blacksmiths who are seeking positions or desirous of improving on those which they have, to register their names and addresses with the free Employment Department of the National Metal Trades Association. Address Commissioner's Office, 605 New England Bldg., Cleveland, O.

PENNSYLVANIA

Wanted—Die setters, die makers, jig and fixture makers and wood pattern makers. Apply at Employment Department, Westinghouse Electric & Mfg. Co., East Pittsburg, Pa.

Mechanical draftsman wanted, experienced in designing tools and jigs; man with considerable actual machine shop practice preferred; state age, experience and salary expected. P. O. Box 579, Reading, Pa.

Wanted—Inside wiremen, tinsmiths, coppersmiths, sheet metal workers, Schwartz and crucible furnace hands and punch press hands. Apply at the Employment Department, Westinghouse Electric & Mfg. Co., East Pittsburg, Penn.

Wanted—A few draftsmen familiar with the design of jigs, fixtures, punches, dies and gages; also some detailers and tracers; tracers must submit samples of their work; only those who have had experience need apply. In answering state age, full experience and wages expected. Box 392, AMERICAN MACHINIST.

Wanted—Plain, slab and portable milling machine hands, horizontal and vertical boring mill hands, automatic screw machine hands, shaper hands, universal tool and shaft grinders. Apply at the Employment Department, Westinghouse Electric & Mfg. Co., East Pittsburg, Penn.

Wanted—We have positions to offer from time to time for the following lists of first-class mechanics: Metal pattern makers; wood pattern makers; iron molders, bench; iron molders, floor; brass molders, bench; machinists; brass finishers, Fox monitor; brass finishers, turret lathe; toolmakers; work consists of brass and iron valves and fittings. In applying for any of the above positions state age, experience and wages. Address F. E. Johnson, Supt., The Kelly & Jones Co., Greensburg, Pa.

WISCONSIN

Toolmaker, first class, one with executive ability, with view of advancing to foremanship. Answer, stating age, nationality and full experience; good opening for right man. Box 381, AMERICAN MACHINIST.

Wanted—Tool designer, capable of designing tools, jigs, etc., for the economical production of work; gas engines and other machinery; Middle West. Address with full particulars, Box 402, AMERICAN MACHINIST.

Situations Wanted

Classification indicates present address of advertiser, nothing else.

CONNECTICUT

Position wanted as master mechanic or chief engineer; experienced in the maintenance and repair of all mechanical and electrical apparatus and buildings in manufacturing plant; have had experience in electric power station, machine shop and manufacturing plant and designing and building special machinery. Box 389, AMERICAN MACHINIST.

ILLINOIS

A successful superintendent of the Otis Elevator Company is seeking change of position. Address Box 230, AMER. MACHINIST.

Position as expert assistant to general manager; specialties, organization, purchase and layout of tools, increasing production in machine shops, foundries and manufacturing plants; wide experience as superintendent; accustomed to large works. Box 422, AM. M.

Salesman—Mechanical engineer, age 28, five years' experience designing various lines, two years' experience selling the trade in central States, desires position as machinery salesman where ability to handle engineering problems would be appreciated; thoroughly conversant in the German language; good references. Address "A. F. E.," AMER. MACH.

Machinery and supply salesman, successful and a live wire, desires change; five years' sales experience, all kinds of machinery, engines, boilers, machine tools, transmission, etc., a specialty; technical graduate; engineer, machinist, draftsman; single, age 28; references of highest order, including present employer. Box 405, AMERICAN MACHINIST.

INDIANA

Foreman toolmaker, jig and fixture designer, experienced in outlining methods and operations in shop, wants to advance in position; go anywhere. Box 340, AMER. MACHINIST.

Situation wanted by a foreman, successful in increasing production and reducing cost of manufacturing; executive ability; expert jig designer; now holding similar position, manufacturing gas and stationary engines, motor and transmission, but desires change. Box 420, AMERICAN MACHINIST.

NEW JERSEY

Wanted—Position, mechanical engineer, five years general foreman shop, twelve years superintendent; A-1 designer on special machinery; technical; hustler. Box 407, AM. M.

NEW YORK

Situation wanted by a mechanical draftsman; experience on Corliss engines, air compressors, pneumatic machinery and gasolene engines; references A-1. Box 417, AM. MA.

Energetic American, age 27, married, technical education, 4 years' experience as machine tool salesman, desires position as purchasing agent for some live and growing concern; employed at present. Box 404, AMER. MACH.

Salesman, electrical and mechanical engineer desires to enter sales department of reputable firm, where ability, representation and good address are required; present location, New York City. Box 423, AMER. MACHINIST.

PENNSYLVANIA

Experienced superintendent open for engagement; large experience in designing and building tools and dies for close, interchangeable parts at the lowest cost; I can get you the results in your shop; best of references. Box 418, AMERICAN MACHINIST.

RHODE ISLAND

A good executive and tool designer now bringing out a heavy sewing machine in southern Ohio, desires change; promises of superintendence with contracts such as to avoid living up to it not considered; responsible parties only need answer. Address O. W. Plant, Care of Z Lambert, 835 Atwells Ave., Providence, R. I.

FOR SALE

For Sale—One-half interest in a fully equipped machine shop with garage attached, in Newport, R. I. Address P. O. Box 264.

For Sale—One 34-inch Walcott shaper, practically new; used very little; inspection or correspondence solicited. Address Desk No. 90, H. Mueller Mfg. Co., Decatur, Ill.

For Sale—One Fifield lathe 22" swing, 24' bed with compound rest, four step cone pulley, back geared, screw cutting, face plate chuck, steady rest and feed gears, all in good condition, $225. Baker Brothers, Toledo, O.

For Sale—Blue print car outfit; frame 30x42 with pad, and car made to revolve and tilt at any angle to get direct rays of sun; made by the American Drafting Furniture Co., Rochester; condition first class; reason for selling, no further use for it. Box 414, AM. M.

For Sale—One Nash gas engine, 20 horsepower, two cylinder, for electric lighting, pumping or power; one Beaman & Smith horizontal boring mill; table 25 inches wide, 36 inches long; will bore 12 inches diameter, 24 inches long, and face 20 inches diameter; one 300 light J. B. Colt Co. acetylene gas apparatus. The above machines are in excellent condition, having been very little used. For further particulars and prices apply to Rider-Ericsson Engine Co., 35 Warren St., New York.

Some Work Performed on Huge 60-foot Boring Mill

Variety of Operations on Extra Large Work Easily Accomplished

By Robert Reid *

Several years ago a 60-foot boring mill designed and built by the General Electric Company for use in their Schenectady plant, was described in several of the scientific papers, and for the benefit of those who have not read that article, it may be said that this machine is capable of turning a piece of work up to 60 feet in diameter when using only about 10 or 12 horsepower. The revolving table is 20 feet 4 inches diameter, with a rack 20 feet pitch diameter that is driven by two pinions set diametrically opposite. The weight of the table, rack, spindle, etc. is about 50 tons.

The mill has been in constant use ever since it was started, about 6½ years ago, running a great part of this time 24 hours per day and 6 days per week. During this time it has only been necessary to shut it down once for repairs, and that only for a few hours. About three years ago, the points of several teeth on one of the bevel gears in the drive having broken off, the mill was shut down long enough to allow for the drilling and tapping of the rim for the insertion of several pins, to replace the parts of teeth broken out; this finished, the mill was again put in operation.

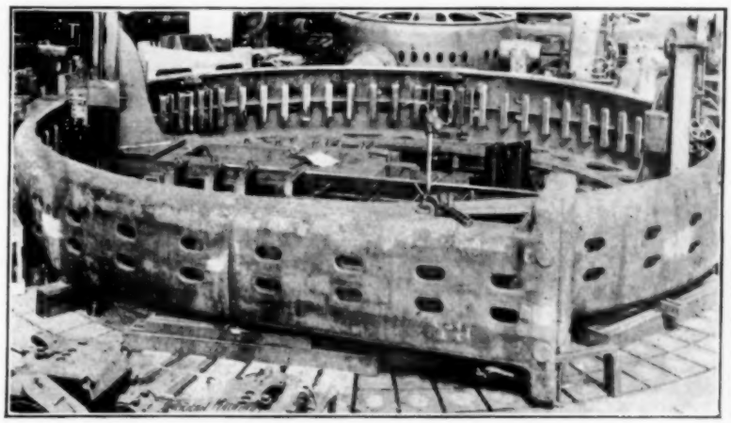


FIG. 1. BORING OUT A LARGE FIELD SPIDER

FIG. 2. BORING AND FACING A 6000-KILOWATT MOTOR FRAME

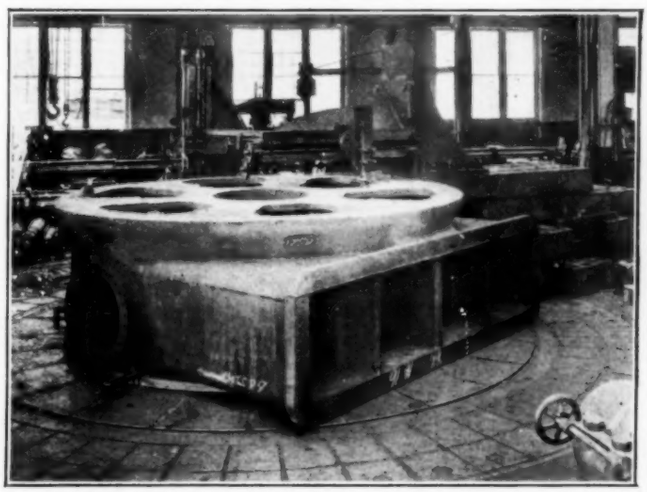


FIG. 3. MACHINING A LARGE EXHAUST BASE

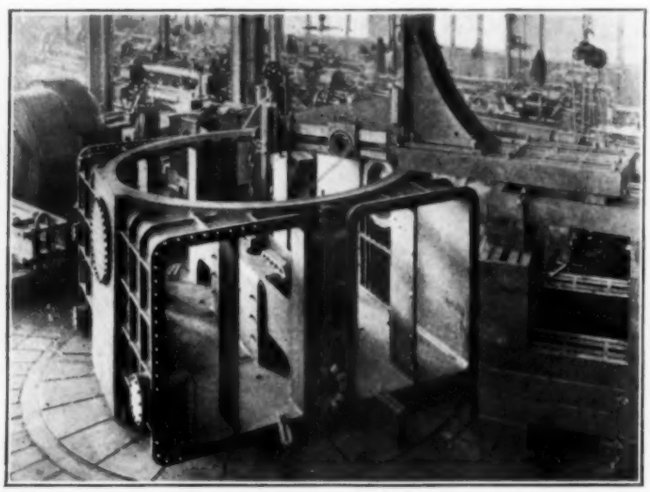


FIG. 4. BORING AND FACING A 9000-KILOWATT CONDENSER BASE

BORING AND FACING

Some of the different kinds of works which have been done on this mill may be of interest. In Fig. 1 is shown the boring out of a large field spider; the bore in this case being about 28 feet in diameter. Here the frame is set upon parallel blocks on the stationary cast-iron floor plate surrounding the revolving table, while the boring and facing heads are mounted on parallels which in turn are securely strapped to the revolving table; the necessary vertical and horizontal feeds being obtained on the tool slide on boring heads, through a star feed.

In Fig. 2 is shown the boring and facing of one of the 6000-kw. motors used at the Gary plant; this method is somewhat similar to Fig. 1, except that boring heads are secured directly to table, as the frame is of much smaller diameter.

In Fig. 3 is shown how an exhaust base was finished. Here one of the boring heads shown in Fig. 1 is strapped to a large angle plate which in turn rests upon several parallel blocks on the stationary floor plate to secure the neces-

*Assistant mechanical superintendent, General Electric Company.

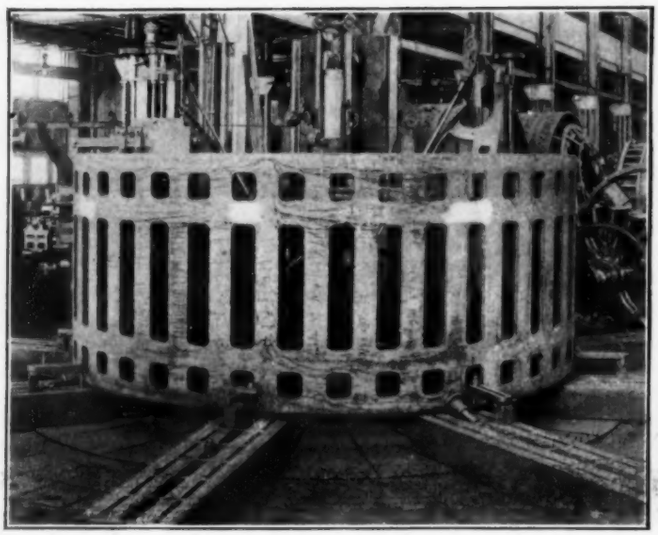


FIG. 5. BORING A 12,500-KILOWATT WATER-DRIVEN TURBINE SPIDER

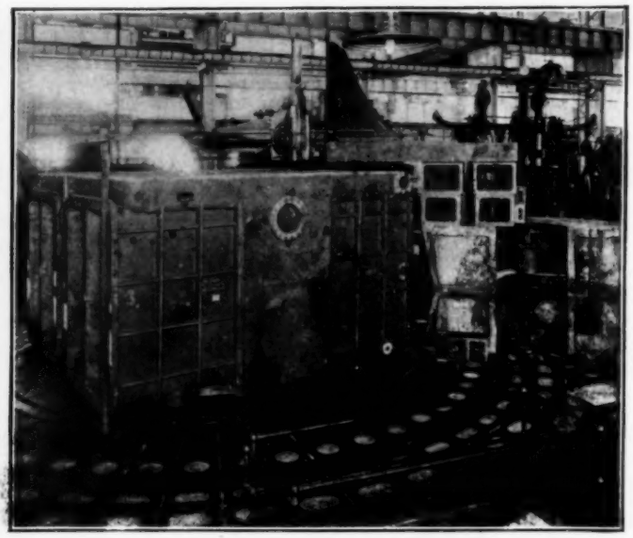


FIG. 6. MACHINING CONDENSER BASE ON LARGE MILL

sary hight, the necessary feed being secured by the star feed, which can be seen on parallel shaft underneath and to the left of the tool head. The work is here revolved by securing it to the revolving table of the boring mill and thus works the opposite to that in Figs. 1 and 2.

MACHINING CONDENSER BASE

In Fig 4 is shown the boring and facing of a 9000-kw. condenser base. In this case the boring head is mounted as in Fig. 3, but much higher, as this casting is about 12 feet high and it was necessary to bore out and face the top and bottom flanges and bore out and face the lower part for the hydraulic step bearing. Particular attention is called to this, as it was necessary, owing to the small diameter, to reach down about 8 or 9 feet and bore out the upper part of step-bearing support by using a long square bar bolted to the tool slide by means of which the feed was obtained.

As there was considerable spring, a second head, with the tool slide removed, was placed on the ways of the facing head and a diagonal brace was put on from the boring bar to this head. The gibs of the second head were set up just loose enough to allow of a snug sliding fit, but yet tight enough to take up some of the spring in the bar.

A 12,500-kw. spider for a water-driven turbine generator is shown in Fig. 5 as it is being machined. You will here notice that the spider is much smaller than the table and that the parallel blocks are undercut a sufficient amount to clear the table so that the work can be held stationary while the tools revolve. In the turning of a large revolving field of the flywheel type, the parallels are usually

FIG. 7. FOUNDATION FOR 40-FOOT BORING MILL

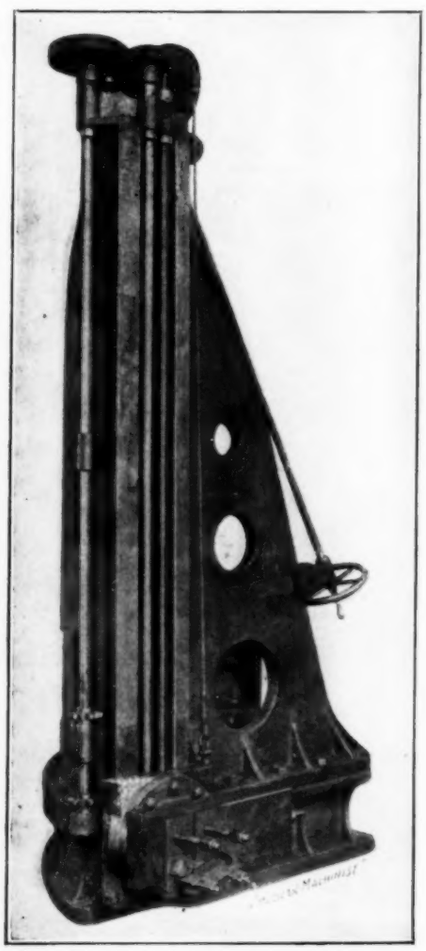


FIG. 8. BORING AND FACING HEAD FOR 60-FOOT BORING MILL

secured to the table and the spider placed upon them and made fast, the facing heads being placed on the iron floor, the tripping of the star for the feeds being effected by one or more dogs bolted to the table or to the parallels.

There are frequently pads cast on the arms of these spiders which require to be finished. We then rig up the facing head as in Fig. 3.

New 40-foot Mill

There has recently been completed by the same company a second mill, which was designed for a capacity of turned work up to 40 feet in diameter. Otherwise it is practically the same as the 60-foot mill.

In Fig. 6 is shown a condenser base on this mill, with the boring and facing stand blocked up in place. But here we see that instead of a square bar they have taken the saddle and ram from a smaller mill and mounted it on the facing and boring stand; the use of the boring and facing stands as shown in the different figures being only of a temporary nature as the cross rails, which were designed for these mills, are not yet finished.

In Fig. 7 is shown the foundation of this 40-foot mill, which is made of reinforced concrete. Considerable thought was given to the construction of this foundation, due to the fact that it was necessary to excavate several feet below the base of two of the main building columns and at the same time not to interfere with the moving to and fro of the large traveling cranes. In this case it was particularly bad, as the soil was of a soft, quicksand nature. However, the columns were shored up and the excavation finished.

This excavation extending about halfway under the column bases, a substantial bed of reinforced concrete was then placed over the entire bottom of the pit and on this were placed heavy steel beams which were pushed under the column bases. After this concrete was well rammed in between the beams. So well was this work done that when the foundation was completed and the shoring removed, the building columns were found to have settled less than half an inch.

In Fig. 8 is shown a special boring head that was made for boring out castings of a comparatively small diameter and very high; in this case the two heads were mounted on the table while the casting is carried on parallel blocks secured to the floor plates as shown in Fig. 5.

In conclusion, while it might seem a rather cumbersome way of performing the operations shown in these different views, it has been found by experience that these machines are capable of doing a piece of work with the same degree of accuracy in 25 to 30 per cent. less time than that required to perform the same operation on one of the standard type of boring mills; a convincing proof of what they can do.

Method of Making Lathe Lead Screws

By F. J. Mulvey

Cutting threads on long lead screws is a job that few machinists have an opportunity to try. I have made lead screws from 8 to 40 feet long, both Acme and U. S. S. for about ten years in a factory building engine lathes. I work piece work and run two lathes on the job. On one lathe I cut the large Acme thread screws; on the other I cut the smaller U. S. S. thread screws. The lathe I cut the long screws on is 30-inch swing lathe, 36 feet 4 inches between centers; it has a quick return attachment consisting of an endless chain which runs under the back of the carriage. The chain is run on a sprocket which is driven by the reverse gears in the head, and can be used for either right- or left-hand threads. When using the quick return the carriage is driven at the rate of 12 inches to one turn of the spindle.

I will now tell how I made a screw 24 feet long, 2 7/16 inches diameter, Acme thread, ½-inch pitch, from the rough bar to the finished lead screw in 24 hours, cutting 19 feet of thread, and turning the bearings on both ends. I take a rough bar of machinery steel 2½ inches diameter, and saw it off the right length, place it in the lathe on wooden supports, and center with an electric drill. Next I straighten it with a hand straightener, which rests on a box and is shoved along the ways of the lathe to whatever part of the bar I may wish to straighten. In straightening a long bar it is best to have as few supports as possible under it. With this bar 24 feet long I used only one support, moving this to different parts of the bar to show up the kinks in the bar. If you use too many supports, the bar is forced to run true, causing trouble when turning. In straightening the most trouble is with the small kinks, which are found in most rough bars. One will straighten out a kink, then another, only to find that the first runs out nearly as bad as it did in the first place. When I get the large bends out of a bar, I mark the kinks that run out one way, then the ones that run the opposite way; then I force the first ones to run out on the same side as the second kinks, then I straighten the second lot of kinks which brings the first ones nearly true. Of course, you must repeat the operation a number of times. In most cases where there is only 1/16 inch to turn off, you will straighten a kink in the bar, then another, say ten feet away, only to find that the first one runs out again. To overcome this, you must force the first to run out the opposite way; then when you straighten the second one it will bring the first one almost true. It takes me about one hour to center and straighten a rough bar 24 feet long. I have taken as much as three hours on one the same length and again even less than one hour. So it is hard to tell just how long it will take, but on an average I take about one hour. After the shaft runs true, I turn the end to fit a cast-iron bushing that I use in the follow rest. In turning, I use two tools, one in the tool post for roughing, the other attached to the follow rest close up to the bushing. In using a bushing you must keep the shaft up to size; if it fits loose in bushing it will wabble and turn out of round. Sometimes the shaft will turn big and small. This is caused by the finish tool cutting too small in the start.

In cutting the thread I use a back rest; also a lever with a weight on the end to hold the screw up against the back rest. The first tool I use is a square tool a little smaller than the bottom of the thread. In roughing the thread, the screw will expand with every cut, the larger the cuts the more it will show, so it is best after each roughing cut to relieve the tail center. In roughing 19 feet of thread it takes about 16 chips, occupying 20 minutes from the start of one cut to the start of another. Next I use a side tool to rough the sides of the threads, cutting one side at a time. The tools I use are high-speed steel 7/16 inch square. I find them better than forged tools, for if one breaks it is easy to replace it. In roughing the sides of the thread care must be taken not to let the chip get wedged between the tool and the side of the thread; this might happen when taking a large cut if the tool is not ground right. After the sides are roughed out, I straighten the shaft again before finishing the screw. This time I straighten the screw as true as possible. To straighten it the second time takes about ¾ hour, sometimes more, sometimes less, it all depending on the stock and the size of the cuts in roughing. After straightening the screw I finish the sides as smooth as possible. The sides must be finished smooth with the tool, as it is hard to take any marks out with a file. In finishing a screw, the tool will sometimes cut rough after it has run over nearly the entire thread. In case it digs in or cuts very rough, one must go over the entire thread to take the marks out, as the work of a lead screw is all on the sides of the threads. To finish the screw mentioned, roughing

and finishing the thread took 40 cuts, and from 14 to 15 hours time.

In cutting screws with a U. S. S. thread I use the compound set over at 30 degrees, and advance the tool forward for every cut, allowing the tool to cut only on the left or cutting side for right-hand threads. I also use the same method in cutting left-hand threads and also in Acme threads of 4 per inch or finer. After cutting the thread about ¾ depth, I use a tool the width of the bottom of the thread, and cut to full depth. After straightening the screw, I use a tool ground the shape of the thread. I set it up above the center and finish the screw cutting on both sides at the same time. When near the finish I am careful not to let the tool cut on the bottom and sides at the same time.

After roughing a screw of 4 per inch or finer, on starting to finish one, you will find that the thread is out of pitch caused by it expanding while roughing the thread. In cutting a long screw, say 30 feet, this causes trouble if one does not leave enough stock to finish. The longer the screw is, of course, the greater the expansion will show. In cutting screws of 4 per inch, on account of the time it takes for one cut, one must make every cut tell. A screw 20 feet long, 4 per inch, takes from 25 to 30 cuts.

A High Speed Milling Operation and Some Other Things

Most mechanics are more or less familiar with high-speed milling operations, and the majority of them will be skeptical regarding the statement that a milling cutter has been successfully operated at a peripheral speed of over 1300 feet per minute. In fact, one is inclined to hesitate about making such a statement for publication, but the following account of a speed record is a truthful one and anyone visiting Cleveland, Ohio, can, with very little trouble, verify it by visiting the works of the Chandler & Price Company, where this cutter is in daily operation.

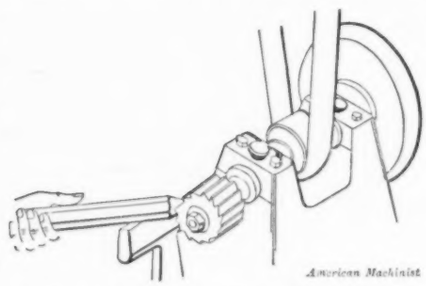


FIG. 1. A RAPID MILLING OPERATION

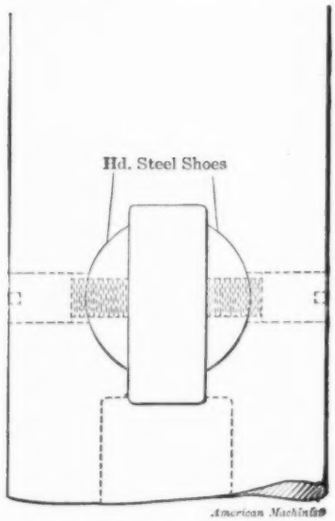
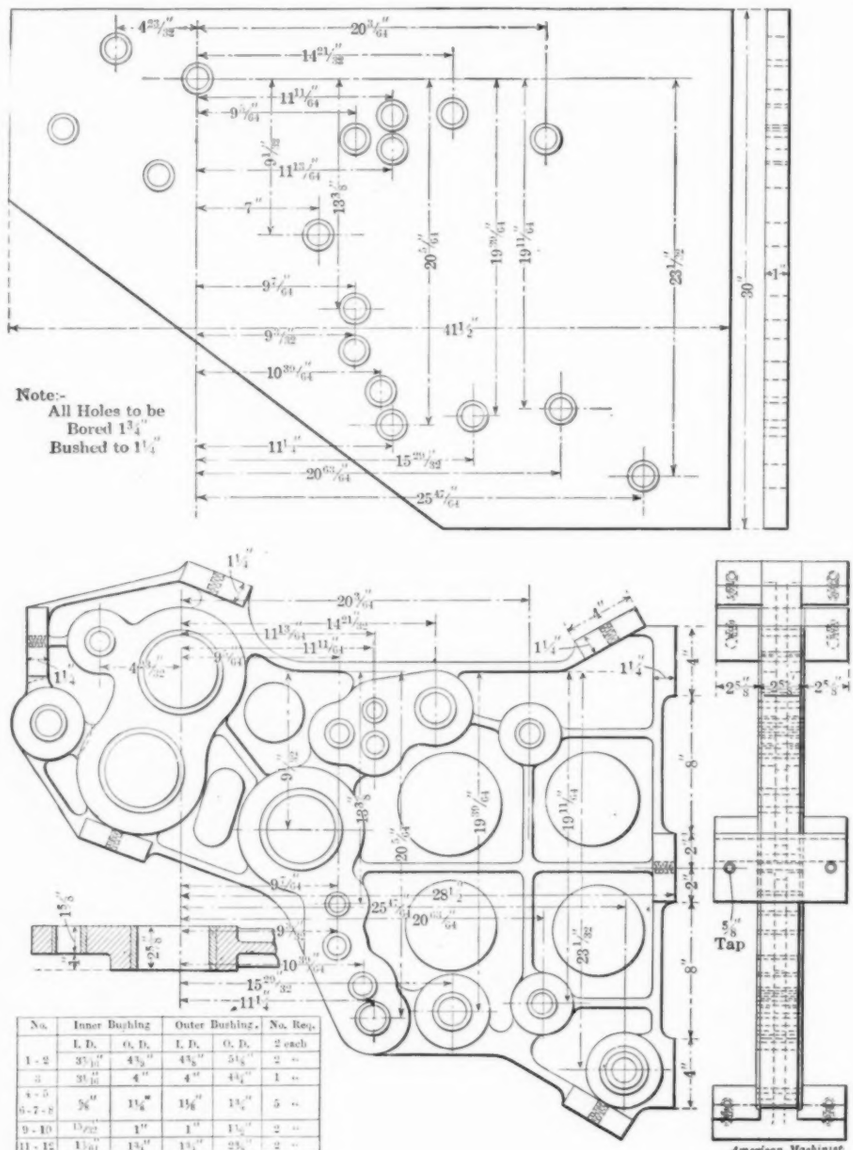


FIG. 3. DRILL SOCKET SCHEME

APPLICATION OF THE CUTTER

Recently an AMERICAN MACHINIST editor called on S. Ashton Hand, superintendent of the above company, and was shown, among other things, this high-speed milling operation. In the screw-machine department a great deal of hexagonal stock is used and Mr. Hand stated that in the past it was customary to knock off the corners of the bar stock before inserting it in the machine spindle, by grinding on an emery wheel or pointing up the bar in other ways well known to screw-



No.	Inner Bushing		Outer Bushing.		No. Req.
	I. D.	O. D.	I. D.	O. D.	2 each
1 - 2	3½"	4⅜"	4⅜"	5⅛"	2 "
3	3½"	4"	4"	4¾"	1 "
4 - 5					
6 - 7 - 8	⅝"	1¼"	1⅝"	1¾"	5 "
9 - 10	13/32"	1"	1"	1⅛"	2 "
11 - 12	1⅛"	1⅜"	1⅜"	2⅜"	2 "
13	1⅛"	1½"	1½"	2"	1 "
14	5/64"	1 5/16"	1 5/16"	2⅛"	1 "
15	11/32"	⅝"	⅝"	1⅜"	1 "
16	9/32"	1¼"	1¼"	1⅝"	1 "
17	1 5/32"	2¼"	2¼"	3"	1 "

FIG. 2. MASTER PLATE AND JIG FOR SIDE FRAME OF PRINTING PRESS

machine operators. It seems that one day a workman found an old carbon-steel milling cutter lying on the bench, mounted it on the emery-wheel spindle, as shown in Fig. 1, and placing the end of the hexagon bar on the rest in front of the cutter, discovered that, with the spindle traveling at its usual high velocity, the end of the work could be rounded off and pointed quickly and very satisfactorily with the cutter running at this abnormally high rate of speed and without apparent injury to the cutter.

A Demonstration

Mr. Hand, stating that he hardly expected the foregoing to be believed, led the way to the department where the cutter was shown in operation. When the wheel spindle was started up and the bar, about one inch in diameter, was placed across the rest and against the cutter, the chips were removed rapidly while the bar was rotated in the hands of the workmen, the operation being accompanied by a light shower of sparks, not, however, so pronounced as in the case of a grinding operation. It took but a few seconds to dress up the end of the stock, and the cutter, when the spindle was stopped, showed no signs of injury, no dulling nor breaking down of the cutting edges. The cutter was 1⅞ inches in diameter and 2 inches long. It was ground with perhaps less clearance than ordinarily used when milling steel, and the chips naturally showed some tendency to stick to the edges of the teeth, as might be expected when removed at such a rate of speed. The cutter, upon examination, did not appear to have been overheated in the operation, but it is difficult to understand how it could have been run at the speed noted without being ruined. This cutter has been used without regrinding, for dressing off and pointing the ends of over 21,000 bars of stock, and it appears to be good for three or four times as many more.

How Can the Cutter Stand Up?

Readers are at liberty to draw their own conclusions regarding this phenomenon. It will doubtless suggest a number of things to men acquainted with machine-shop processes. Presumably, the fact that the bar of material is gripped in the hand, instead of being held rigidly, gives a cushioning effect which relieves the cutter to a certain extent and prevents its edges from going to pieces instantly.

As previously noted, the cutter diameter is 1⅞ inches, and the spindle upon which it is mounted runs at 2700 revolutions per minute. Multiplying the latter by 5.9 inches, the cutter's circumference, and dividing by 12, gives the actual speed as 1328 feet per minute.

Master Plates and Jigs

All of the jigs and fixtures used by this concern are made from master jigs or plates, so that the working tools may be checked up at any time or replaced entirely with the assurance that the new tools will be correct. A master plate and the corresponding jig are shown in Fig. 2. These tools are for the side frame of the printing press. The jig is made for use on both right- and left-hand side frames. The boring of the holes in jigs and fixtures is accomplished on a horizontal boring machine upon the table of which the jig to be bored and the master plate are mounted and secured against an angle plate or other suitable support. The work and master plate are clamped together and the table of the machine is adjusted until a test collar, carried on the boring bar, will slip nicely into the hole in the master. All the holes in the master plate, it should be mentioned, are provided with hardened, ground and lapped bushings, so that the plate retains its accuracy permanently. After the boring bar is located correctly relatively to the work, the master plate is removed and the hole in the jig, which has already been roughed out by drilling, is bored to size. The plate is then replaced, the table adjusted until the test collar slips into the next hole in the master and the corresponding hole is bored in the jig, this process being repeated until all of the jig holes are bored.

All of the holes in the jigs at this shop are provided with soft-steel lining bushings, into which are fitted the hardened guide bushes for the drills. In this way the original seats bored in the jig retain their acuracy; so, in case of a drill bushing turning while the jig is in use, if the steel liner in which it fits becomes torn it is a simple matter to remove it and put a new one in place, thus all wear is avoided in the original hole bored in the jig.

The engraving, Fig. 2, shows only a few typical dimensions to give the general scheme of putting on the figures. Actually, the blueprints contain center distances for every hole, both horizontally and vertically, and give the exact location of every important working point. The jig drawing shows all of the soft-steel bushings in place, but none of the hardened and ground drill-guide bushings, a table of which is included in the drawing.

A Drill Socket Scheme

Fig. 3 illustrates a scheme adopted here to prevent the tangs of drills from injuring the socket of the drill spindle. A hole is bored cross-wise of the spindle and of sufficient diameter to include nearly the length of the drift slot and then two hardened steel shoes are fitted in place at opposite sides of the slot and secured by headless screws, as indicated in the sketch. The inner faces of the shoes form the contact surfaces for the sides of the drill or drill-socket tangs, and it is impossible for the shoes to become injured, no matter how hard the drill may be forced in the work.

Another Use for Steel Balls

Editorial Correspondence

Mechanics who have always looked upon the steel ball as useful only for bearing purposes will be somewhat surprised to learn that large quantities of balls are and have been for some time used for burnishing metal parts. While this process has been used for quite a number of years in the manufacture of jewelry, and more recently has been applied to the burnishing of small sheet-metal parts in the nature of buckles and similar pieces, it is but little known in the mechanical world, although it is said to be applicable to almost any small metal parts which require a burnished surface or which have to be polished as a preliminary operation to be followed by plating.

The process consists in placing the work in a tumbling barrel, preferably of the horizontal type and made of wood so as to prevent scratching of the work, and then dumping into the barrel a large quantity of small steel balls measuring in bulk about twice that of the work to be burnished, togethed with a soap mixture, in which the work and the balls are confined or held together so that as the barrel rotates, the whole mass of soap, work and balls is tumbled about, causing the balls to be forced in all directions across all of the work surfaces, thus giving a constant burnishing action. The length of time through which this process is continued for any given job depends upon the size and nature of the work and the size and number of the balls used. Obviously, where the balls are quite small and a large quantity relatively to the amount of work is used, the time required to produce a highly burnished surface is comparatively short. The time, however, may range from one to several hours, depending upon various conditions. It is necessary that the soap used should be of a mild nature, so as not to stain the work; burnishing compounds are also used in place of the regular soap mixture. The process, as stated, takes the place of buffing both before and after plating on such articles as electrical goods, chains, buttons, thimbles, typewriter and other parts.

Naturally, when one considers using,

say, a couple of pecks of steel balls for the burnishing of thimbles or other small parts a peck at a time, the question of expense will come to mind instantly and lead one to wonder how the process can be an economical one, even though the balls are used over and over again. It seems that steel balls are being manufactured for this purpose, and an AMERICAN MACHINIST man in conversation with Mr. Abbott, of the Abbott Ball Company, Hartford, Conn., learned a number of interesting things in connection with the manufacture of these burnishing balls. As Mr. Abbott explained, the balls he makes for burnishing are not produced to the fine limit of accuracy which we expect of bearing balls, although the process of manufacture automatically drops these balls out so that they are graded within a limit of about 0.005 inch. Accuracy as to size and sphericity is not essential. Neither is an occasional flat spot an objection. It is important, however, that the balls should be hard and as smooth as it is possible to make them. The balls made by the firm referred to are carbonized steel and polished after hardening. In sizes they range from ⅛ inch to ¼ inch. Mechanics accustomed to buying two or three balls upon occasion to repair roller skates or bicycles will be interested in the measurement of balls by the peck. According to Mr. Abbott, there are approximately one hundred pounds of steel balls to the peck Of the ⅛-inch size there are 3125 to the pound. Of the ¼-inch size, 430. As a matter of curiosity, the writer learned that in the case, say, of the ⅛-inch balls, when purchased in reasonably large quantities, the three thousand and more going to make up the pound cost not over thirty cents, with ¼-inch balls, proportionately less.

Points on Straightening Motor Belts

By John F. Hobart

When the belt which transmits power from the motor to your machine or line shaft begins to wabble and sidestep instead of pursuing the "straight and narrow way," do not nail up an edging or a scantling to keep the belt from running off the pulleys. Instead, pay a little attention to the condition of the belt. Take out the fastening, stretch the belt out on the floor and note if it lies straight from end to end, or if it forms a segment of a rainbow. Perhaps the belt lies in a snaky direction, exemplifying the time-honored equation *Sin.* $x = y$, which is frequently applied to the steps of late returning persons as well as to motor belts and alternating current representations.

The cause of the meandering direction of the belt can usually be traced to one or two causes: Either the belt maker was very short sighted and could not distinguish between the belly and the back of a hide, or he stretched the back of the hide clear up into the neck. The result is much the same. In either case, when the belt stretches it seldom stretches uniformly on each edge, hence its tendency to follow the example of a mountain railroad and take a look occasionally at its own rear end.

There are also two ways by which such a belt can be made useful in the shop. One way is to stretch the belt as much as possible by running it, then take it to pieces. Take out all the lacings and stretch each piece flat. Then, if the lengths be short ones, cut them straight by cutting off the edges of the belt until each piece is straight, though narrower than before. Then put the belt together again and it will run much better, although many of the pieces will have to be put into narrower belt widths.

The other way requires the services of a belt maker, who will take the belt entirely to pieces wherever there is a crooked place. If it is a double belt he will take out the "laps" as the separate lengths of leather are known to the trade; then he will cut each lap into lengths which are approximately straight, after which he will cement up the belt again. This method shortens the belt but does not make it narrower. The first method narrows the belt but does not shorten it much. Which method should be used depends upon the belt—and the belt maker.

Some belts of the cheaper class "short lap," if you please, but cut from the belly or flanks or hides, are put together (double belts only) with the laps alternating so that the edge nearest the back of one strip is placed opposite the belly edge of the strip which is opposed to it. In this manner the tendency of a lap to become bent in a certain direction is opposed by the lap riveted thereto, which has a tendency to bend edgewise in the opposite direction. While this is a method of putting cheap material into high-priced belting, it will not make a belt which is much, if any, stronger than a single belt. The reason for this is that when the belly strips begin to bend edgewise, the entire stress is thrown upon the bit of back leather which chances to be opposed to the leather which is bending out of shape.

There are many of these kinks and dodges put into use in order to obtain good prices for inferior belting, for, unfortunately for the leather belting business, each steer has only one back to go with two sides and belly strips. Hence the belt maker must find some way of disposing of the extra supply of inferior material But it must be stated, to the credit of the belt maker—and of the salesman also—provided the manufacturer can make him do it always—that belting is very seldom misrepresented to the purchaser. If he asks for first-class belting and is willing to pay the price, he will get first-class belting every time. It is only when attempt is made to get a cheaper belt, that the belt salesman gets in his work, and even then, it is the sin of omission, rather than of commission!

Specify your leather belts to be: "Well tanned oak or hemlock, cut not more than 18 inches from center of back, laps not to exceed 4 feet 6 inches in extreme length and to weigh at least 16 ounces per square foot without including filling or dressing." Let these specifications be rigidly followed, pay a fair price for the belting to a reputable belting manufacturer, put belts together with a good splice or approved fastening, and your shop belts will not chase flies around the room while driving shaft or machine. One more thing is necessary and that is: after you have obtained good belts, keep them so by periodically cleaning and oiling. Treat the belts as well as you do the machines and there will be no trouble with them until they have reached the time limit and have worn completely out.

Cleaning With Gasoline

The cotton work gloves, the "Six-Pairs-For-A-Quarter" kind are most excellent for shopwear, but they will get so dirty that the wearer is often puzzled which side out they could be worn to the greatest advantage. A wash in gasolene will quickly remove the grease and most of the other dirt, but look out when you try this wrinkle and not get caught as one man did.

He washed the gloves in a pint of gasolene in a dish and threw the dirty hydrocarbon out of the door upon the ground. Just then he thought it would be amusing to see the gasolene burn, so he thoughtlessly lit a match in the old convenient way, intending to throw the blazing bit of wood into the spilled gasolene. But he didn't have time for that. Instantly his gloves, which were on his hands, were all ablaze. He made two flops with his hands, for he didn't lose his head for a second, even if he did lose his gloves. One of the gloves flew off at the second "flop," but the other stuck half way on. The man stooped quickly, stepped on the fingers of the blazing glove and drew it off his hand so that not a bit of skin was scorched, although the hair on one wrist was singed.

A Successful Apprenticeship System in a Large Plant

Development of the Boy the Chief Aim. Production Secondary

By Charles H. Logue

At the works of the Westinghouse Electric and Manufacturing Company, East Pittsburg, Penn., the apprenticeship system is developed and stimulated in a most careful and systematic manner; the first vice-president of the company taking an active part. A section of the plant is devoted to this work; where, for the first two years of the course, the boys are under the guidance of shop instructors having the rank of foreman. These instructors are all-round mechanics taken from the shop, and chosen for their interest in young men as well as their skill as workmen.

There are at present 88 boys in this department and 143 other apprentices are scattered throughout the works, having

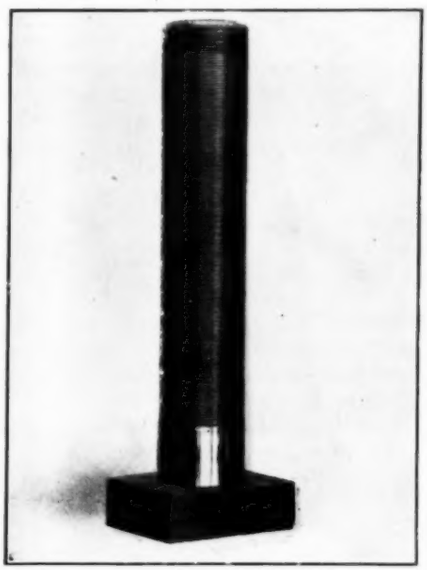


FIG. 1. COPPER TERMINAL BOLT

served two years or more. There is a waiting list of about 50, from which approximately 10 are selected per month. About one-half of the applicants are rejected; the company picks the boys for native ability and manly qualifications rather than from past experience or education. It is found that such boys quickly pick up the necessary rudiments and take a genuine interest in their work. So far the desertions have been less than 4 per cent.

Previous to March, 1909, all the apprentices were scattered through the works. The plan did not meet with success, as it was difficult to keep track of the boys to see that they were receiving proper instructions; that they were not kept on one machine too long; that they were not laid off during dull periods. The result to be attained, that is, the training of skilled workmen, was often lost sight of in the necessity of maintaining production.

The watchword of the present apprentice department is the development of the boy, production being of secondary importance. While the boys are employed on the regular product of the company, its rapid completion is not considered.

MACHINE-TOOL EQUIPMENT OF APPRENTICE DEPARTMENT

The department is equipped to furnish shop practice in all branches of the machinist trade. The boys are moved from machine to machine in the following order:

Drill press, 2 months; shaper, 2 months; planer, 3 months; engine lathe, 6 months; vertical boring mill, 3 months; plain and universal milling machine, 5 months; bench work, 3 months.

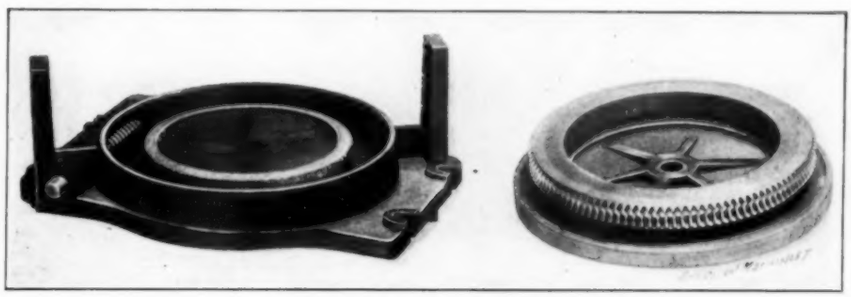


FIG. 2. MILLING MACHINE FIXTURE MADE IN APPRENTICE DEPARTMENT

This department is also equipped with slotters, Newton and Ingersoll millers, universal grinders, turret lathes, etc.

After the first two years (5480 hours), the boys are transferred about the works, as seems best for the individual boy, according to his natural ability.

The apprentice course of four years (10,960 hours) is divided into four periods.

The first three months (685 hours) of the first period is a trial term; after which, if the applicant proves satisfactory, an agreement is made with the boy's parents.

WAGES PAID

For the first period of 2740 hours the pay is 9c. per hour, for the second period of 2740 hours 12c. per hour, for the third period of 2740 hours 15c. per hour, for the fourth period of 2740 hours 18c. per hour. All time in excess of the regular working hours of each day, the apprentice will be paid at the rate of time and one-half. Upon satisfactory completion of the course each apprentice is given a gratuity of one hundred dollars.

WORK DONE BY APPRENTICES

The apprentice department takes care of the milling-machine work usually carried on in the tool room; such as making milling cutters, end mills, reamers, taps, etc.; suitable work is taken from the shop as it is required to keep the boys steadily employed; the apprentice department being given the preference in all cases. This work is subjected to the regular shop inspection; the percentage of loss due to defective workmanship being no greater than in other departments in the same class of work.

All test pieces are machined in this department, the interest of the boys being aroused by giving them the history of each piece and the results obtained by the test.

A section is fitted up for bench work; the boys making their own repairs, as well as repairing and assembling new parts in broken tools for the balance of the shop.

The boys are also taught to lay out their work and to assemble completed parts.

Gear cutting of all description is a feature of this department.

Figs. 1 and 2 show samples of the boys work Fig. 1 being a copper terminal bolt which is turned on an engine lathe in one and one quarter hours by boy with three months lathe experience. Fig. 2 is a good sample of what the boys are capable in a better class of work.

Care is taken that the boys start out with proper ideas regarding production, and that proper habits are formed. For instance; the boys are first cautioned to make sure of the cutting speed, the feed being increased as the boy becomes more skilful. They are taught to take pride in the conditions of their machines and

tools as well as the general appearance of the department and are urged to make it a model for the rest of the plant. Each boy is made to feel that he is an important factor in the future development of the company; one unruly youngster being brought around to see things in the proper light by having his own case presented to himself as foreman.

The Class Room

An outline of the class-room work is given in this extract from an address of C. R. Dooley, who is in immediate charge of the class room instruction.

"In the class room instruction is provided on the company's time, and is conducted throughout the four years of the course. This work is part of their daily schedule, the apprentices reporting to the class room as systematically as to the shop foreman. Suitable rooms inside the works have been fitted with tables, desks, blackboards, etc., much the same as any ordinary schoolroom. The atmosphere is hardly that of a school, but rather that of a class where boys are given problems and explanations concerning the things with which they work every day, instead of problems in abstract mathematics. In connection with the character of the class work, there are three vital points: 1. The scientific principles underlying the subjects must be taught. 2. These scientific principles can best be presented through the working of practical problems dealing with the work and things of the boy's everyday life. This will hold his interest. 3. The same problems must teach him certain facts and specific knowledge concerning the things with which he is working, such as weights, costs, strength of material, gear speeds, pulley and belt speeds, etc. In fact, a knowledge of these things with which the problems deal and the facility offered for thinking about these very ordinary things may be the most valuable feature of this instruction.

"As a specific case, consider the subject of addition of fractions and mixed numbers. Instead of an abstract group of such quantities to be added, the boy is given this problem.

"A shaft has two shoulders. The length from one end to the nearest shoulder is 3⅞ inches. The length between the shoulders is 1 foot, 4½ inches. The length from the second shoulder to the other end is 4¾ inches. Allowing 3/16 inch at each end for finish, what length of stock will be required to make four shafts?

Section	Division	Monday, 7 to 9 A.M.	Tuesday, 7 to 9 A.M.	Wednesday, 7 to 9 A.M.	Thursday, 7 to 9 A.M.	Friday, 7 to 9 A.M.	Saturday, 7 to 9 A.M.
A	1.	Mechanical Drawing, Mr. Elers and Mr. Rosstead			Shop Problems, Mr. Edwards.		
	2.	Shop Problems, Mr. Edwards.			Mechanical Drawing, Mr. Elers and Mr. Rosstead.		
B	1.		Mechanical Drawing, Mr. Sanderson and Mr. Rosstead.			Shop Problems, Mr. Dean.	
	2.		Shop Problems, Mr. Dean.			Mechanical Drawing, Mr. Sanderson and Mr. Rosstead.	
C	1.			Mechanical Drawing, Mr. Kennedy and Mr. Rosstead.			Shop Problems, Mr. Watson.
	1.			Shop Problems, Mr. Watson.			Mechanical Drawing, Mr. Kennedy and Mr. Rosstead.

APPRENTICE CLASS SCHEDULE OF THE WESTINGHOUSE ELECTRIC & MFG. CO., PITTSBURG, PA.

"Nor is this type of problem too simple for the average apprentice; of a class of 103 beginners, 45 could scarcely add or multiply decimal quantities and knew practically nothing about proportion and percentage.

"There is yet another phase of the work without which all else would fail. For want of a better name, we call it spirit. It includes loyalty and enthusiasm, not only in the work and in the future it holds for the boys, but also in their daily relations with their fellows—a spirit of service and willingness, confidence in all things and all people, and eternal optimism. This may be illustrated by the following incident:

"The second week of the operation of the class work included a holiday which happened to come on Monday. One boy in the Monday class complained of his hard luck in losing a period owing to the holiday. Another boy was congratulating himself upon being in the Tuesday class.

"At present, the class work is scheduled under two general heads: 1. Mechanical drawing. 2. Shop arithmetic. Each of these subjects embraces a certain amount of the general subjects of shop problems—tool construction, tool operation, shop organization and system, as well as the fundamental science of the subject itself."

Casino Technical Night School

In addition to the regular course, the boys are encouraged to attend the Casino Technical Night School which is fostered by the Westinghouse companies. A graduate in good standing of the Casino school is priviliged to make application for the two years engineering apprentice course.

The boys are encouraged to read the current mechanical papers; a liberal supply of which are kept in the reading room attached to the class rooms, also to do mechanical drawing at home. The boys are furnished with drawing boards, tools and supplies at a nominal cost for this purpose. In the class room the company supplies these.

A series of lectures are given in the class rooms by the mechanical experts, engineers of the company, and others.

Mechanical drawing is taught for practical shop use, the boys using their own drawings. For beginners, the part to be drawn is first roughly sketched and dimensioned, the drawing being made from this sketch. The fewest possible views and dimensions are used to correctly represent the piece and to avoid any calculations on the part of the workman into whose hands it is placed. Dimensions are also shown in a manner best suited to the machine operations.

These drawings are made to include a list of material, allowances for fits, working limits, finish marks, etc.; provision is also made to keep track of any changes or corrections that may be made according to the Westinghouse practice; all of which are included in a standard book which is maintained by the company.

Each boy is given individual instruction according to his ability or previous knowledge. Two hours at mechanical drawing and two hours at shop arithmetic, of two days of each week in the class room are scheduled for each apprentice. Details of this schedule are shown in accompanying diagram.

The technical training of the Westinghouse establishment is under the general supervision of an apprenticeship committee, consisting of Charles F. Scott, consulting engineer of the company, an authority on electrical engineering known in this country and Europe; Chas. E. Downton, assistant superintendent in charge of apprentices, and C. R. Dooley, who has immediate direction of the instruction.

Gear Hardening Practice at the Light Mfg. and Foundry Co.

The gears used in the transmissions of the Stevens-Duryea car are made of chrome-nickel steel. Owing to the rigid requirements, which will be given later, the problem of hardening presents many difficulties. The gears after hardening must show a hardness with the scleroscope of between 80 and 86; these are the extreme limits, a gear showing a hardness of either 79 or 87 will not be accepted. The scleroscope itself is calibrated every morning with a standard test piece. Should the ball or drop of the scleroscope be found to be incorrect, it is stoned. I do not know whether this is usual practice but it seems good and in this shop, where nothing but the best is good enough, it works out all right. By continuous impacts the drop becomes flattened on the end and will rebound higher than it should to show a certain degree of hardness. The stoning is to reduce the area of the end and hence the hight of rebound. The sliding gear has a square hole through it for the square shaft which it fits and in this case the word fit means it for these gears are a snug sliding fit for the shaft and the shaft fits equally well in any of its four positions.

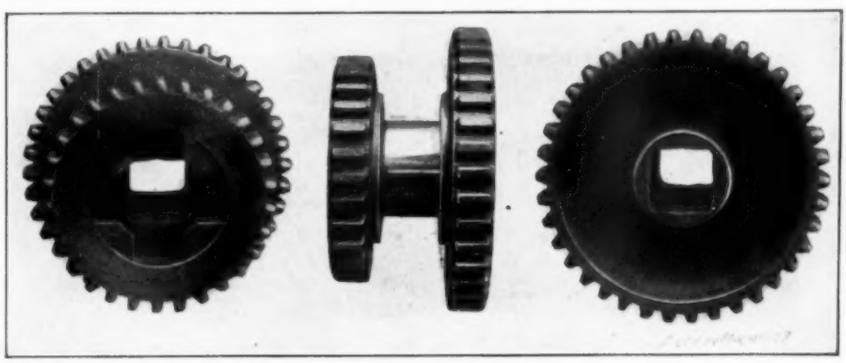


FIG. 1. A CHROME-NICKEL STEEL GEAR WHICH IS A DIFFICULT PIECE TO HANDLE PROPERLY

Fig. 1 shows the sliding gear known as No. 61. It will be noticed that this gear has a hollow at the large end. The hardening or heat-treating plant, whichever you prefer, consists of an American Gas Furnace Company's No. 1 oven furnace and two oil tanks about 4 feet diameter by 4 feet deep fitted with cold-water coils just inside the shell. These tanks are filled with fish oil to within about 8 inches of the top. The hardening tank is provided with a wire basket which is attached to a rope and may be raised or lowered at will. A Bristol Electric pyrometer is used to determine the temperature of the oven but here as elsewhere there is required brains, good eyesight and an acute sense of color, besides gumption, horse sense and a lot of other things that you can't buy for so much and hitch onto an electric wire. Formerly the gears shown in Fig. 1 were dipped with the large end, having the depression, down. This method gave considerable trouble, the pieces warped badly and had to be straightened with the hammer which, of course, was not good. The temperer reasoned out that the faulty work was probably due to the imprisonment of air in the depression which prevented the oil from reaching this part. So a change was made and the small end dipped first. This gave excellent results.

The furnace for tempering is first raised to a temperature of 750 Centigrade. When the oven reaches this temperature the gears, a number at a time, are put in and every now and again turned so that they heat evenly. For this part of the work the aforementioned human attributes are brought into play and the temperer *sees* when a piece is at the right heat for dipping.

It is essential that the pieces be dipped perpendicularly; for this purpose there are pieces of bent wire as shown in Fig. 2. One of these wires passed through the hole in the gear and the two hung on the hook *C* held by the temperer, enable him to dip the pieces perpendicularly, it being impossible with this rig to do otherwise. Each piece as it i dipped rests on the flat bottom of the wire basket and the tops of the pieces are probably a foot below the surface. When all the pieces have been put into the first wire basket the basket is raised and lowered by means of the rope referred to before so as to circulate the oil and distribute the heat more evenly. When sufficiently cooled the pieces are lifted out and put in another seive in the other tank but above the surface of the oil to drain.

With the double gears it sometimes happens that the one gear is harder than the other. As long as the difference in hardness in the two ends is within the prescribed limits the gears are passed as O.K., but should either or both of them be too hard, that is to say beyond a hardness of 86 on the scleroscope scale, then the gear is brought back to the temperer to be drawn to the correct temper.

Fig. 3 shows a device used by Light Manufacturing and Foundry Company, when drawing the temper on the gears. It is merely a thick plate of cast iron the walls of which are probably two inches thick. We will for instance suppose that one of the double gears has been found by the scleroscope to be too hard on both ends. For the information of those who do not know it may be mentioned that the scleroscope test is always made on a tooth or teeth which have been polished so that the hammer strikes clean metal and not scale. These polished places are used by the temperer when drawing the temper, it having been found by experience that the bath of hot oil with a thermometer to record the temperature is not reliable for the purpose.

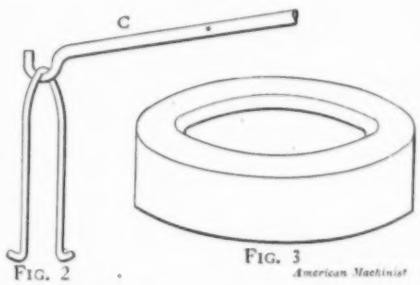


FIG. 2 FIG. 3 *American Machinist*

TWO HARDENING ACCESSORIES

The bottom of the furnace is, of course, cooler than the top. In the case of drawing the temper on the double gear referred to the large end of the gear is drawn first. For that operation the gear is put into the furnace with the small end resting on the bottom and cooler part of the furnace. The large end being in a hotter part of the furnace the temper of it will be drawn first. The temperer keeps his eye on the polished teeth and when the right color is reached the gear is removed from the furnace and dipped in the fish-oil bath. After the gear is sufficiently cool the plate shown in Fig. 3 is brought into service. The large end of the gear fits in the cylindrical recess in the iron block, Fig. 3. The two are then placed in the furnace, the mass of cool metal in Fig. 3 keeping the large end of the gear, which has been drawn to the correct temper, from heating while the small end of the gear is being drawn to the correct color.

Experience has taught that, in drawing gears which are too hard, it is incorrect to draw all degrees of hardness to the same color. For instance: A gear which shows a scleroscope hardness of 88 would be drawn to a very light straw and would then show on the scleroscope scale a hardness within the prescribed

limits, i.e., 80 to 86. One showing 90 would be drawn to a dark straw with the same results, and one showing 100 on the scleroscope would be drawn nearly to a blue color.

This drawing to a color has proved entirely satisfactory with these gears, although my own experience in tempering carbon steel has taught me that drawing to a color is not satisfactory.

There is, however, one thing in connection with color drawing in carbon steel; with steel of the same composition if one piece is hardened a little harder than a similar piece, drawing to the same color will bring them nearly alike. This rule does not seem to hold on chrome-nickel steel, as shown by the description given.

Card Systems for Drawing Room and Shop

By C. T. Schaefer

From time to time there has been considerable discussion concerning engineering and drawing-room recording systems and this article is to explain the system used in the engineering department of several well known automobile factories. The factors taken into consideration when this system was placed were: First, the rapidity with which a thing looked for could be found; second, to keep an accurate account of all blueprints sent out from the drawing room; third, to be able to locate patterns immediately.

The somewhat greater care needed to keep a complete system such as this, in order, hardly amounts to anything, compared with the time wasted in trying to locate what is wanted with an incomplete or patched-up system.

The Drawing Record

Drawing sizes are 5x8, 8x10, 5x16, 10x16, 10x32, 16x20, 20x32, 20x48, 32x40 and 40x64 inches. These sizes are all multiples of 5x8 inches and are filed in a cabinet in which the drawers are divided to suit the various sizes of drawings, while the blueprints kept in the drawing room are filed in another, similar cabinet. Fig. 1 shows the drawing with title and number. The title, the material, the number required per car and the type of car, are placed in the upper left-hand corner, as shown, and the drawing number in the upper right-hand corner. The title, stamp and number are to be placed on the side which is a multiple of 8 inches.

In Fig. 2 is shown the drawing-record card. These cards are placed in a cabinet, all numbered in consecutive order, and as the tracer completes the drawing, he is required to take the next blank card, number the drawing accordingly and fill out the blank spaces on the card, such as name, assembly number, drawer number and title, while on the drawing, in the stamp, he is required to place the draftsman's name and his own name and date. The letters *D*, *T*, *C* and *A* in the drawing stamp, stand for drawer, traced, checked and approved. The drawing is then checked and signed by the checker, after which it is passed to the chief engineer for his approval. After he has approved the drawing, it is ready to be printed.

Blueprints are made by the clerk who is held responsible for the prints and the entire card system. This clerk notes on the card in the proper column the date and to which department or departments, the prints are issued. When the print is returned the department returning it is given credit for it on the card. At times changes are made and the date, nature of change and by whom ordered are placed in the column marked "Corrections and revisions," and if the part is replaced by some new design, this card is marked "Superseded by Number ———" and carried in the card file. It can readily be seen that in this way, parts can be checked with ease. In case prints are mailed to any individuals or companies, this is noted on the back of the card, the date, name and address being recorded.

The Stock Lists

Stock lists of assemblies are issued to the different departments, showing such items as motor, clutch, gear box, axles and chassis, and are arranged as shown in Fig. 3. The idea of these stock lists is to help the foreman in locating the numbers of the different pieces and the number required per assembly. In automobile work there are numerous small

Hand Hole Plate Clamp Stud.
3/8" Rd. Screw Stock.
4 Req'd. Type B.

EMMET, Mc NEAL & CO.
LOUISVILLE, KY.
No 4113

D	a L W.	2/8/10	C	CRS	3/3/10
T	EF	2/10/10	P	"	"

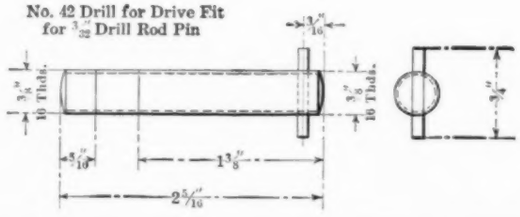


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Fig. 1. Sample Drawing Showing References

DRAWING NO. 4113 DRAWER NO. A-5×8
NAME Hand Hole Plate Clamp Stud
ASSEMBLY NO. 4212

CORRECTIONS OR REVISIONS

DATE	NATURE AND REASON	ORDERED BY

Tool Room BLUEPRINTS

ISSUED	RETURNED	ISSUED	RETURNED	ISSUED	RETURNED	ISSUED	RETURNED	ISSUED	RETURNED
3/7/10									

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Fig. 2. Drawing Record Card

pieces that assemble in other parts and are permanently fastened. These parts are taken care of as follows: Referring to Fig. 3, in the first column the piece numbers are entered, while in the second column are entered the numbers of pieces that become permanently fastened to those entered in the first column as, for example, the hand-hole cover plate No. 4142 has four dowels riveted into it. The numbers of the dowels are entered in the second column following the No. 4142, showing that they are part of the piece No. 4142. Now, when the assembler draws the plate from stock, he gets the plate and dowels complete. By having the stock lists arranged in this manner the stock keeper and the cost department can easily get the data required and the advantage gained in so arranging the sheets can readily be seen. The sheets are put on file in the different departments and each foreman has his own file.

Crank Case
Hand Hole Cover Plate Assm.

No. 4212. 4. Req'd.

Piece No.	Piece No.	No. Req'd	Name	Material	Remarks
4142		1	Cover Plate	Alum. Cast	
	4112	2	¼" x ½" Dowell Pin	¼" Drill Rod	
	4114	2	¼" x ⅝" " "	" " "	
1113		1	Hand Hole Plate Clamp Stud	⅝" Rd. Screw Stock	
		1	3/32" x ¼" Pin	3/32" Drill Rod	
4115		1	Thumb Nut	Std. Forging	
4125		1	Hand Hole Plate Clamp	¼" x 1" Ft.C.R. Steel	

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FIG. 3. ASSEMBLY STOCK RECORD SHOWING WHAT PARTS GO TOGETHER TO MAKE AN ASSEMBLY FOR STORE ROOM

METHOD OF CARING FOR BLUEPRINTS IN THE SHOP

Blueprints are issued to the tool room and from there they are issued to the machine shop, with the necessary tools and fixtures for the job. When the workman in the shop is given a certain job, the foreman of that department gives him the shop card and he is required to present this card to the tool room, to get the blueprint. When he receives the blueprint he hands the tool-room foreman a check, this check to be hung on a rack below the number of the blueprint. This rack has the numbers of all the blueprints marked on it and by referring to the rack it can at once be seen whether or not a print is in use. When the workman returns the print his check is taken from the rack and returned to him.

As before stated, the drawings are multiples of 5x8 inches and are filed in the tool room in boxes; one 8⅛ inches wide and the other 16⅛ inches wide. The 5x8-inch and 8x10-inch prints are placed in the small box, the 8x10 being folded to 5x8 inches. The other prints are placed in the large box, the larger size being folded to 10x16 inches and all filed in numerical order. All prints, excepting general assemblies, are kept in the tool room, the assemblies being issued from the drawing room, direct. In caring for blueprints in this manner it is very easy to locate any print when corrections are to be made.

THE PATTERN RECORDS

The patterns, when completed, are numbered, as are the drawings, and recorded on the card shown in Fig. 4. By referring to the card, the master and gate pattern can easily be located; also the cost of both patterns and total cost, the shrinkage allowed, the number of loose pieces to the pattern and core boxes, the date and by whom the patterns were made. In the upper right-hand corner of the card provision is made to take care of the pattern, should it be carried in the company's pattern room. Thus, a very comprehensive statement of all pertinent facts are included on the card record. The card is very simple and needs no further explanation.

PATTERN NO. 4142

NAME Crank Case Hand Hole Plate

DESCRIPTION	LOOSE PIECES	CORE BOXES	LOOSE PIECES	SHRINK	MASTER PATTERN SECTION	MASTER PATTERN TIER	MASTER PATTERN SHELF	PATTERN SECTION	PATTERN TIER	PATTERN SHELF	ORDER NO.
	X	X	X	11/64"							

GATED BY	DATE	GATING COST	MASTER COST	TOTAL COST	REMARKS

SENT TO	DATE	RETURNED	SENT TO	DATE	RETURNED
Moore-Jones	3/1/10				

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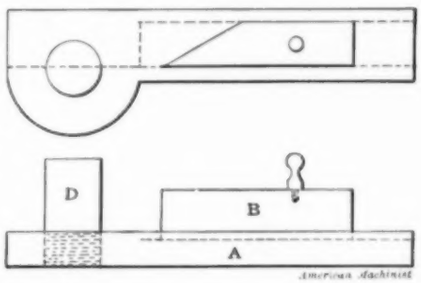
FIG. 4. PATTERN RECORD CARD

A Convenient Gear Cutter Tester

BY E. H. MCLEOD

A very useful instrument for the grinding room of a shop cutting its own gears, is shown in the accompanying sketch.

It consists of a piece *A* upon which is accurately dovetailed the sliding piece *B*. In the piece *A* is also screwed the stud *D* ground to one thousandth of an inch below the size of the hole in the cutter.



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GEAR CUTTER TESTER OF SIMPLE CONSTRUCTION

The cutter to be tested after grinding is placed upon the stud and the slide *B* is moved until it bears successively upon each of the ground faces of the cutter. By holding the cutter up to the light, a slight variation from the radial line can at once be seen.

As every machinist knows, it is essential that cutters be ground upon radial lines, otherwise the teeth cut will have an improper shape and the gears will not mesh correctly.

This appliance, as far as I know, is not manufactured by any firm but several homemade ones are in use in shops here.

Notes on the Design and Efficiency of Impulse Pumps

Principles Generally Misunderstood. Some Important Advantages

By John Richards

There are employed in pumping three common types of apparatus for raising and forcing liquids; namely, displacement or piston pumps operating positively as to volume in nearly all cases; centrifugal pumps operating in part by centrifugal force and in part by impulsive effect, and purely impulse pumps or apparatus such as hydraulic rams. There are besides these types other methods of pumping, such as direct lifting by Norias, entrainment devices like the Catalan apparatus, the injector or ejector and pneumatic pumps, but the three first named constitute the types in common use.

The whole subject of fluid impulsion makes up a wide field, 10 times as wide as is commonly supposed, and is still more extensive and complicated if we include in this field "fluid motors." These latter have become a science instead of an art and much more advanced in their "evolution," as it may be called, than the fluid impelling types.

The hindrance to arriving at a settled or scientific practice in any of the arts is nearly always found in the diversity of application, and in this respect there is a great deal more diversity in the impelling or pumping type than in the motor type. The latter, for example, have in the hydraulic class only water to deal with, but the pumping class have hundreds of diversified uses. There is, however, a strong analogy between the two classes, and theoretically the forces employed should be quite the same, or as nearly so as possible.

Theoretically, or in the abstract we may call it, the forces are the same. To put it in words; the gravity pressure and flowing energy are to be dealt with the same, and aside from machine and atmospheric frictions, apparatus to either impel or receive the impulsive effect of water should attain a dynamic efficiency of 90 per cent. or more than this if we correctly direct the forces dealt with.

Such is the fact indeed. The highest class water wheels utilize this much of the kinetic value of the water and the highest class pumping apparatus does the same. The losses in both cases are to a great extent from like causes, and to trace these out is a first step toward attaining the best form of construction and manner of operating in both cases.

Mathematical solution of these problems has only the value of explaining, confirming and reducing to record the circumstances of practice, and as this proposition may meet with criticism, it may be noted that the computations respecting pumps of the old familiar displacement type had to all be gone over again 10 or 15 years ago when Riedler published his *Indikator Versuche auf Pumpen,* which after all was but a step toward the fact that intermittent movement of the fluid caused a corresponding loss of effect.

One of the most efficient displacement pumps I ever met with cost about $8 and was in a country kitchen. It was single acting and the pipes, head and other conditions favored continuous flow. The valves went "out of commission" and the flow at a certain rate went on continuously by certain impulses imparted by the bucket when operated by hand. . have never met with an intelligent analysis of

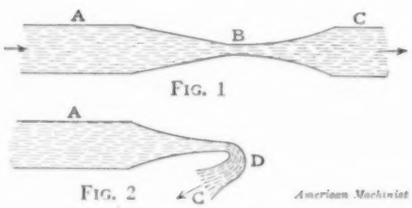


FIG. 1

FIG. 2

DIAGRAMS OF WATER UNDER HEAD

this feature of continuous flow except in centrifugal pumping.

I may here point out that this simple hand-operated pump could not have produced the same result operated by crank motion or in any other manner of applying machine power, because the motion of the bucket had to correspond to and supplement the flow in the pipes. This is obvious, and there is little doubt that a continuous flow single acting pump is the most efficient type, if there was only some way of applying the impelling power at the rate of flow. We may compute the velocities, the area of water-passages, and arrange those to conform to mathematical laws, but when we come to construct a pump these quantities will have to be laid aside to accommodate the accidental passage of solids, also circulation and more obscurely "cavitation." Then also there will be the problem of useless rotation after the water has reached the velocity required by the head or resistance.

In stage pumps of the rotary kind we may even have to recognize the strange phenomenon of "kinetic stability," or what is sometimes called "gyroscopic action" when the revolving mass is to be moved laterally, or normal to the plane of rotation. This is not now computable. Messrs. Sulzer Brothers, of Winterthur, Switzerland, who for many years experimented with centrifugal pumping apparatus and applied to it all the computations of others as well as their own, found in the end what we may call a lot of inexplicable phenomena, as Riedler had done in displacement pumping. They went on, however, to a successful manufacture, which scores of others have done the firm the honor of imitating.

Centrifugal force is indirect, and however useful in its many adaptations, must always be accompanied by unavoidable losses, by excessive water friction, indirection the same as in other types. All have their losses and will continue to have; but this is no reason for not attempting to minimize such losses and logically understanding them.

Suppose, for example, we have a body of water under a head of 100 feet pressing in a pipe, as in the diagram Fig. 1, and we want to employ the force of the water for useful work. Gravity apparatus that would use or apply the whole section at *A* would be cumbersome and expensive, both by its dimensions and slow action; hence we abandon direct gravity methods and resort to combined pressure and impact.

The section of the conduit is gradually reduced to the point *B* and the velocity increased accordingly until it reaches a maximum due to the head, $(\sqrt{2gH})$ practically eight times the square root of the head in feet per second, or 4800 feet per minute at *B*, and at this point we introduce apparatus to utilize the energy of the water, and why not do the same for impelling it?

Impulsive turbine water wheels are commonly employed for high pressures, and on the vanes of these is received the impact or spouting force of the water, but not completely. It rebounds, is deflected laterally, and if not provided for, its residual force is lost. A cone of fixed water may be piled upon the resisting vanes of the wheel, causing a broken lateral discharge and the energy is lost; so we must complete the *C* end of the diagram, to avoid this. To use a homely expression, "Here trouble begins."

There are two ways, nearly equal, to utilize the residual energy of the fluid after its impingement at B by gradually reducing the velocity as at *C* and converting it again to pressure, but a more practical way is to reverse at this point the course of the water and employ its reactive effect, as illustrated at *D*, Fig. 2. Here is where turbine motors are introduced. There is a choice of two types, inclosed or pressure turbines, and open

or impulse turbines, the latter for high heads and velocities and the former for low heads. In both cases the *C* end of the diagram, Fig. 1, must be contained "in the motor itself," because the water cannot be returned to a conduit or pipe to reconvert its energy to pressure.

Confining remark to the impulse or tangential type of motors, which are easiest to understand and in some respects most advanced in practice, we come first to receiving curves and conditions; the receiving surfaces being rotative cannot be kept normal "to course of impingement," but approximately so or within a curve or angle that permits outward flow. If flat, the water is scattered and much of its energy lost; hence in the Pacific Coast type of tangential wheels the impinging stream is split into two parts directed laterally right and left, leaving two distinct residual angles or curves that bring the water to a state of rest, or with no velocity—not as in the diagram at *C* and converting the energy back into pressure, but reversing its course and utilizing the reaction, which is nearly the same thing in effect, except as to water friction and some losses by imperfection of the process. This leaves, however, a very satisfactory result, reaching in the best apparatus 85 or even 90 per cent. of the water's gravity, and is perhaps the best we can ever hope to attain.

Inclosed or pressure turbine motors operate in the same manner, or nearly so. Section *C* of the diagram, Fig. 2, is represented by the reversal of impact and reaction, perhaps forming a compound of pressure and gravity; but for present purposes we need not go further into this subject.

Reverting next to the main subject of this article, a very natural question arises: Why cannot this operation be reversed, changed to impulsion? The conditions are nearly the same.

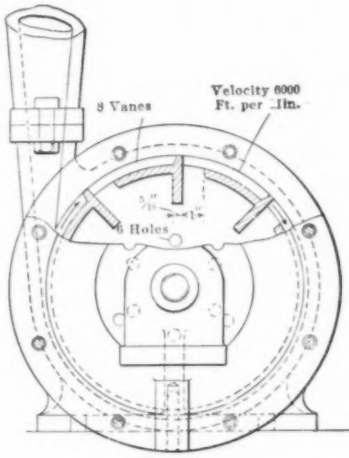


FIG. 3

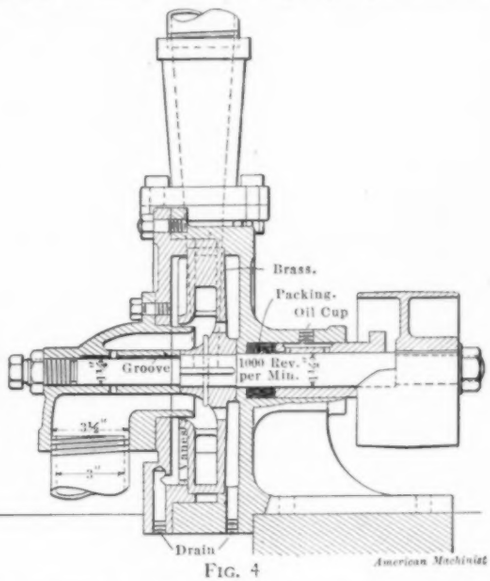


FIG. 4

DESIGN OF A ROTATIVE PUMP—ESSENTIALLY AN INVERTED TANGENTIAL TURBINE

ROTATIVE PUMPS

The first and main reason that so little attention has been given impulsion pumping has been the intervention of "centrifugal" action, which is simple, convenient and especially adaptable to impure water and rough uses, also the apparatus is cheap to construct; but it is not efficient unless it includes careful provision for utilizing the energy of the water's revolution—not the whole energy of revolution, but the main part, or what remains after deducting the excessive water friction, but unfortunately demands specific proportion and speed for each head.

To begin at the beginning, the author, who originated and first applied stage or cumulative centrifugal pumping on the Pacific Coast, a matter of half a century ago, proposed in 1902 to introduce more impulsive and less centrifugal action in this type of pumps and made some abortive attempts to consummate the object without adopting the obvious hydraulic conditions required. He submitted his views in a crude way to a number of engineers; among these, J. J. Brown, of the International Pump Company, who alone among the number seemed to understand what was aimed at.

The concept had its origin in some facts that can be presented here, also to the general proposition of reversing the action of impulse motors, as already was explained. The facts are that in some experiments made at New York there seemed to be some strange and desirable effects produced by contracting the discharge orifices from the impellers, or, as he may say, approaching the dimensions at *B* in the present diagram, Fig. 1.

Next came the Sulzer high-pressure rotative pumps called "centrifugal," with their chief characteristic, a contraction of water ducts at *B* and utilization of the after flow at *C* by reconverting the energy of flow into pressure, and notwithstanding tortuous water passages attaining better results than had preceded.

About the same time, S. N. Knight, of Sutter Creek, California, after making some interesting experiments with the "Bourdon" system of centrifugal apparatus, and meeting with various impediments, began further experiments with common centrifugal pumps by reducing the impeller discharge orifices down to attain a theoretical or even a smaller area and raise the velocity of the water above that due to the head or resistance. The result was an increased efficiency and so have been all attempts, so far as known, to augment impulsive action with less dependence to supply the "anteduct," it may be called, and to prevent "cavitation," also to direct the discharge to a tangential course.

In speaking of the work of Reidler, a friend aptly described it by saying: "He is the man who found out what goes on inside of a piston pump." This is true, but his task would have been more difficult still if he had set out to find out what goes on "inside of a rotative pump," employing centrifugal action. Impulse, tangential energy and reaction, all combined in some unknown relation and degree, which we lack the light to explain or even understand.

The objective theme of this article is to suggest that in rotative pumping, the following features would conduce to efficiency, reduce first cost and improve the practice in all but the cheaper class machines:

1. Reduce the section of the water passage at the point of impulsion and raise the velocity there to balance the head or resistance.

2. Confine centrifugal action to the functions of "induction" to supply the zone of impulsion and to prevent "cavitation."

3. Increase the impulsive action by reducing water friction to its lower limits and the range of rotation to 180 degrees or less than this.

4. Provide a diverging discharge way to convert the tangential velocity to discharge pressure.

5. If possible, drain the impeller chamber in pumps of one stage to eliminate thrust and lateral water friction.

To illustrate a manner of carrying out these features, a drawing (Figs. 3 and 4) has been prepared. It contains some errors, no doubt, but none to interfere with its purpose here.

The drawing is for a pump of 3 inches discharge, and suction pipes and velocities for an assumed head of 100 feet. The area of the impulsion zone is 0.5 inch, and the velocity there, 90 to 100 feet per second.

The contour and appearance is that of a centrifugal pump, but it is "not one" in any but the limited sense heretofore

explained. It is in its main features an inverted tangential turbine.

For 10 years past there has been a wide, or even international effort to improve pumps acting mainly by centrifugal force and with a far from satisfactory result. The best engineers and mechanics in this country, in Germany, Switzerland and France, have given their efforts to this purpose, with the result of low efficiency, high cost, want of endurance and no really scientific or settled solution.

Centrifugal force is secondary, and in a sense is indirect. It has its place in rotative pumps as a means of supplying rotative impellers of high speed and in future may be relegated to this function.

Emergency Welding Apparatus

By W. I. Reich

One of the most useful applications of fusion welding is the repairing of automobile parts. A number of shops are established to do this class of work, at a reasonable price, but in all cases the work has to be taken to the shop. To overcome this an auto truck was equipped with welding apparatus, as shown in Fig. 1 for the purpose of giving "first aid to the injured" within a radius of 50 miles from the city, with day and night service.

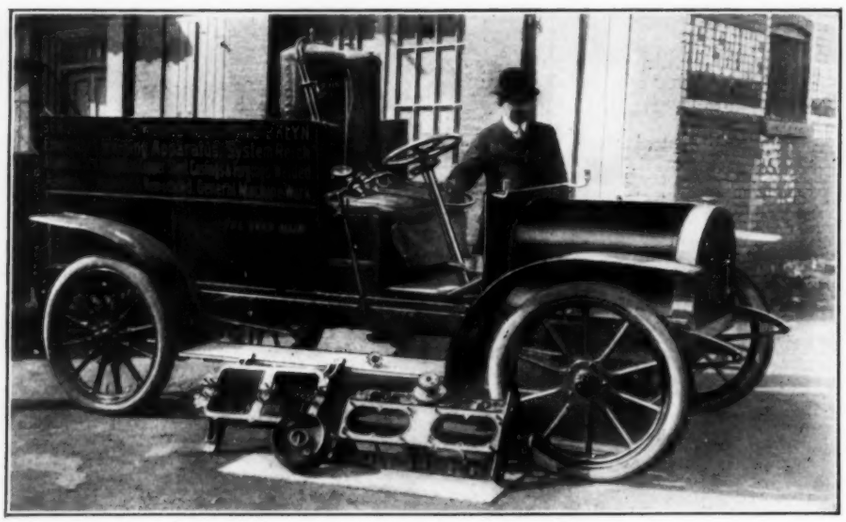


FIG. 1. WELDING OUTFIT MOUNTED ON AUTOMOBILE

A 24-horsepower Darracq car, with a speed of 40 miles per hour, was used by increasing the wheel base 18 inches, by cutting the frame and welding in a new piece of angle iron. The body was made of 1/16-inch sheet steel with stiffening ribs welded on. It is provided with oxygen, acetylene and compressed illuminating gas cylinders, a welding torch, a cutting torch, gas regulators, rubber tubing, and a complete tool chest.

The outfit is primarily used for small, but vital repairs. At its foot are shown some welded automobile parts, such as an aluminum and a malleable-iron gear case, a cast-iron clutch pulley, a steel clutch, with broken and repaired teeth, and worn off and rebuilt clutch prongs.

OXY-ACETYLENE TORCH

The oxy-acetylene welding torch and its application were fully described on page 1147, Part 2, Volume 32, of the AMERICAN MACHINIST. In Fig. 2 is shown the oxy-acetylene cutting torch, which is the welding torch with an extra pipe and tip added for the extra blast of oxygen. This oxygen jet can be supplied through the angle cock, from the oxygen used for heating, when cutting steel up to 1 inch in thickness; or when cutting steel 6 inches or more thick, the angle cock can be set to obtain its oxygen supply through the free end, by means of rubber tubing to a high-pressure oxygen tank. In the first case only one rubber tube is used for both the heating and cutting supply of oxygen and one for the acetylene. In the second case a third tube is used to supply the extra oxygen jet for cutting. The cutting torch can be readily used as a welding torch, by removing the heating tip and the small copper tube, that furnishes the oxygen jet for the cutter, and replacing them by a welding tip.

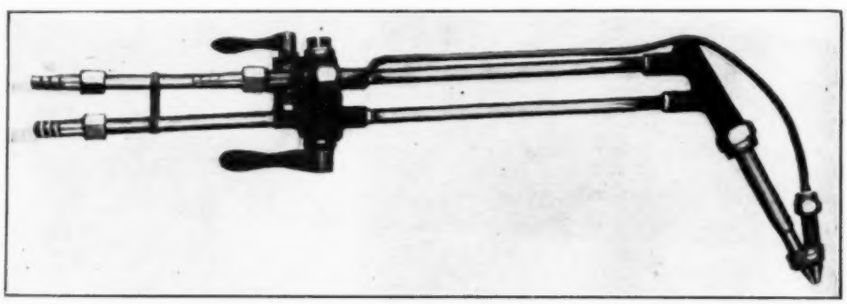


FIG. 2. COMBINATION CUTTING AND WELDING TORCH

OXYGEN AND ILLUMINATING GAS TORCH

In Fig. 3 is shown a torch for oxygen and illuminating, or natural gas. The torch is similar to the acetylene blow pipe and provided with a double cock, that will regulate the oxygen independently of the gas. The head contains a backflash safety device, and the tip is fastened to the torch, by means of a ground joint and union. There are 3 interchangeable tips. In these, both gases are mixed and then expanded in a larger chamber, after which the mixture is again contracted in a special mixer. The mixer has, besides a large central opening, multiple small, annular, spiral openings that feed the central flame in case an excessive pressure should tend to blow it out. The tip is provided with a bend, and by means of the union it can be set to any desired angle. The oxy-gas torch can be used for sheet steel welding up to $\frac{1}{8}$ inch, and for aluminum, copper and brass up to 3/16 inch thickness.

BRAZING

It is the most useful for brazing any reasonable thickness of metal, and particularly where an ordinary gas and air blast would warp the piece due to the large area heated by the flame. The heating should be started with a soft flame, and finally bring the piece up to a brazing heat, by adding more oxygen to the flame. By this method tanks can be made cheaper than by the acetylene process or even by riveting. The seam can be made lapped, or double seamed, to insure a good mechanical joint. As a flux borax is used, and brass or copper rods are melted and run into the joint. For very thin metal, we can employ with advantage a

4 to 10 per cent. silver solder, as this has a high strength and runs easy.

The fusion welding and brazing process is now extensively used for compressed gas tanks, oil transformer tanks, acetylene gas buoys, sand dredging pipes, pipe headers, etc. In the above cases a riveted joint, exposed to temperature and variable pressure differences, also to corrosion, would soon spring a leak. The riveted pieces are in most cases 25 per cent. heavier, due to the low efficiency of the joint in comparison to the efficiency of the welded or brazed joint. It was recently introduced in the manufacture of metal bedsteads, to replace the cast-iron joint, and in making hospital metal furniture and operating tables. The welded joint replaces here the screwed fitting and riveted joint, making the apparatus fully aseptic.

Saving Effected

The saving effected by welding was very apparent in the case of ammonia headers of 4 inches diameter, with six 1-inch outlets. The former cost of the 4x1-inch tee was $2.25, and the total cost of welding per outlet was about $1.50. To the cost of the fittings must also be added the cost of cutting the pipe, and the soldering of the joints, to make the same tight, and none of these items are added to the welding. Ammonia storage tanks are also welded, that were formerly made with screwed and soldered heads, thus saving on weight and cost at least 30 per cent. Another manufacturer reported a saving in welding concrete buckets at 25 per cent. over the riveted bucket, and they were not only tighter but also lighter in weight.

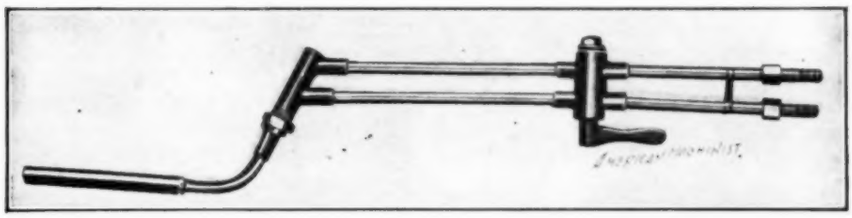


Fig. 3. Oxygen-Illuminating Gas Welding Tools

In one of my installations in Pittsburg, some large buoys were recently welded which were 100 feet in diameter and about 9½ feet high. The two bump heads, and the longitudinal seams were welded. In this case the joints were overloaded with fused metal, and removed with pneumatic tools to leave a smooth and seamless joint on the outside. The speed of welding on the ⅜-inch tank was about 4 feet per hour, when welding it cold and 6 feet per hour when it was preheated with natural gas. These buoys were tested to 25-pound pressure per square inch, and found to be as good as any of the European welded cylinders.

We are somewhat behind France in the welding and repairing of steam boilers. This is largely due to the conservative attitude of the boiler-inspection authorities, but it is fortunate that we did not go into this important class of work, until we have educated a reliable corps of welders. In Marseilles, at the works of Le Chetalier, no welder is allowed on boiler work, unless he is an expert boiler maker by profession and has had at least 6 to 8 months of good welding experience.

Operation of the Federal Liability Law—*Special Correspondence*

The Federal Liability Law granting compensation to injured workmen in United States manufacturing establishments, arsenals, navy yards, etc., was approved by Congress May 30, 1908, and took effect August 1, 1908, or nearly two years ago.

As will be recalled, this law provides, in effect, that when any artisan or laborer employed by the Government in any of its manufacturing establishments or in the construction of river, harbor, fortification and certain other work, is injured in the course of such employment he shall be entitled to receive for one year thereafter, unless able to resume work in the meantime, the same pay as if he continued to be employed; provided that no compensation shall be paid under this act where the injury is due to the negligence or misconduct of the employee injured nor unless said injury shall continue for more than fifteen days. If the employee dies during the year because of such injury, leaving a widow, or a child under 16 years of age, or a dependent parent, they shall be entitled to receive the same amount for the remainder of the year that he would have received as pay as if he were alive and continued to be employed.

Believing that our readers will be interested in an article dealing with the actual application of this act in its various provisions in a typical government factory, we have secured particulars of its operation in the United States Armory, at Springfield, Mass. This account we are enabled to publish through the courtesy of General William Crozier, Chief of Ordnance United States Army, and Colonel S. E. Blunt, Commanding Officer at the Springfield Armory.

Number of Injuries and Amount of Compensation

The operation of the law at this armory, one of the establishments of the Ordnance Department of the army where the United States rifle, model of 1903, and various other small arms are manufactured, has been very beneficial to the employees affected, they receiving when in the course of their employment the same pay as if they continued to be employed. In the period during which this act has been in operation, there have been employed on an average 1100 men. Of these employees there have been 41 injured, 20 of them for a period of less than 15 days and the balance for a period of more than 15 days. No injuries resulting in death or in prolonged disability have as yet been received, the longest period for which a man has been absent under this injury law being slightly less than two months. The total amount paid employees at the armory since September 29, 1908, when the first injury under this act was received, has been a little less than $1000 with three claims amounting to slightly more than $200 still pending.

Nature of Injuries

Of the 41 injuries noted, a considerable number were due to falls and to falling objects. Seventeen cases come under this classification, these consisting mainly of sprains, strains and bruises, though in two cases bones were fractured. Of injuries in the nature of cuts, mainly on hands and fingers, received while working around band and circular saws, gears, cutters and other tools, there were nine; injuries to the eye, caused in most cases by flying pieces of metal or abrasives, five; wounds in the nature of punctures, due to slivers and nails, four; strains and abrasions not otherwise classified, six.

Emergency Treatment

For emergency use in case of injury or illness of any of the employees, five medicine chests with complete supplies are located in different departments of the armory.

There is a contract surgeon, one of the Medical Reserve Corps of the Army, employed at the armory as the attending surgeon for the officers and enlisted men stationed there. There is also a surgeon of the Hospital Corps of the Army, a regularly enlisted soldier, in charge of

the Post hospital, who in case of serious accident is immediately called upon to give emergency treatment, and the Post Surgeon, if available, is called upon. Reports as to the services they render are made to the commanding officer each month. Owing to the location of the armory in the residential section of Springfield there are a number of civilian physicians in the vicinity, and many employees, if they are injured, prefer to have their own physician called, and as a result in a number of cases civilian physicians have rendered emergency treatment before employees were sent home.

Where the injury is serious enough to make it necessary for the workman to be sent to his home or to a hospital, one of the Post vehicles of the armory is used for the purpose. The medical treatment given outside of the armory is, of course, beyond the province of the armory officers and is given as the employee may desire upon request which he makes of his usual attending physician.

Leave of Absence

If an employee is disabled because of an injury received in the course of his employment and there is leave of absence due him under the Act of Congress of February 1, 1901 (this act grants each employee of navy yards, gun factories, naval stations and arsenals of the United States Government 15 working days' leave of absence each year without forfeiture of pay during such leave) the pro rata amount of such leave to which he is entitled at the beginning of his absence may, if the employee so requests, be applied to cover, in so far as it is sufficient, the whole or a portion of such absence as provided in the case of ordinary sickness. In this connection it may be stated that when an employee has attained the leave status (which he does by first serving a year as an employee of the Government) and is subsequently absent on account of sickness, the period of such absence will be charged against the amount of annual leave not previously taken which has accrued to him at the beginning of his absence on the basis of a day and a quarter per month of service rendered in his current leave year. When absence on account of injury covers a period of more than 15 days and the employee claims and is allowed compensation on account of his disability he is paid for the entire period of his authorized absence under the Act of May 30, 1908, without charge against his leave.

Prospect of Broader Provisions

The ordinary leave is supposed to compensate an employee at least partially for the loss of time caused by short periods of illness or accident and the Act of May 30, 1908, is intended to cover the more serious cases of accidents which would incapacitate an employee for longer periods for which the loss of pay would be a serious matter. The government employees appreciate the benefits of the injury act and it is thought it is not unlikely that later on Congress may liberalize it in a conservative manner by giving besides the present allowance to the injured employee an amount sufficient to cover extra expenses involved by his injury because of doctors' fees and similar charges, and also that some provision will be made to compensate injured employees, who have not attained their leave status by having served one year in government employ before the injury happened, for periods less than the fifteen days now required before claim for compensation for injury can be made. However, taken altogether, it is believed that the two acts (the fifteen days' leave of absence with pay law and the compensation for injury to employees law) offer a more liberal consideration than is generally found in private establishments.

An Important Ruling

An interesting decision by the Attorney General, as published by the Secretary of the Department of Commerce and Labor (under whose jurisdiction comes the settlement of claims for compensation for injuries under this law) has been made as to the question "Whether an incapacitation directly attributable to the work, but not the result of a sudden accident, warrants compensation to the employee injured under the Act of May 30, 1908." He states: "The statute quite consistently provides for the cases of injuries in the course of the employment and accidents resulting in death or otherwise. The word 'injury' is employed comprehensively to embrace all the cases of incapacity to continue the work of employment, unless the injury is due to the negligence or misconduct of the employee injured, and including all cases where as a result of the employee's occupation he, without any negligence or misconduct, becomes unable to carry on his work, and this condition continues for more than fifteen days. The word 'accident' is employed to denote the happening of some unusual event, producing death or injury which results in incapacity for work lasting more than fifteen days. That is to say, within the language of the statute an employee may be injured in the course of his employment without having suffered a definite accident.

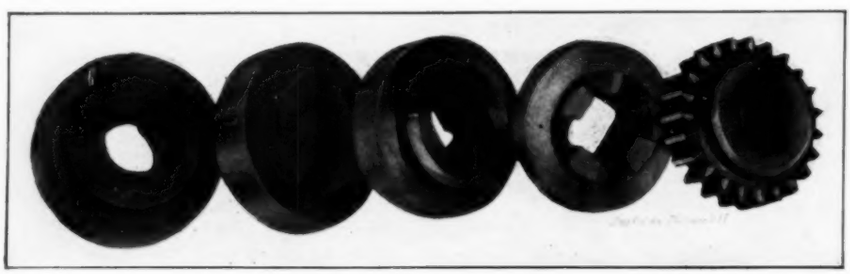
A Broad and Liberal Interpretation

"This is a beneficent statute, in the nature of an act granting pensions of limited duration and of special application. The language employed appears to me to be clear and unambiguous, and should not be so construed as to exclude from its benefits any of those cases which it fairly includes. I therefore, deem it unnecessary to enter upon an extended discussion of the authorities which have dealt with the definition of the word 'accident' as distinguished from 'injury,' although there are many interesting precedents dealing with such definitions; and the modern tendency of courts has been to apply the term 'accident' to include all injuries arising out of the pursuit of claimant's employment, which, without his fault incapacitate him from carrying on his labor."

Machining a Clutch Gear Having a Square Hole

By E. A. Dixie

The halftone shows a clutch gear made of chrome-nickel steel. The blanks come in the shape of drop forgings. The first operation is done on a Foote-Burt drill press which drills the central hole at the rate of 100 in 10 hours.



Machining a Clutch Gear

The second operation, broaching the square hole, is done on a La Pointe broaching machine at the rate of 120 in 10 hours. The third operation is rough turning on a Jones & Lamson flat turret at the rate of 50 in 10 hours. The fourth operation, finish turning, is also done on the flat-turret lathe at the rate of 50 in 10 hours.

The teeth, 24 in number, are cut on a Follows gear shaper at the rate of 20 gears in 10 hours. The clutch is milled on a Whitney hand miller at the rate of 60 in 10 hours. The teeth are then pointed in a Lipe tooth-pointing machine at the rate of 750 complete gears in 10 hours.

Economical Features of Electric Motor Application *

The principal object of this paper is to show from actual tests and investigations of existing installations, how a problem in motor drive can be handled in order to show its maximum economy. It will endeavor to show that the hourly cost of operation is dependent upon the characteristics of the various types of machine tools, from the standpoint of power and time required. The load and time factor of the tool will be taken into account and the influence of this factor on the cost of production. Data are also given upon the electric-motor equipment of machine tools, with suggestions for its standardization.

There are certain types of tools in which the operations to be performed require constant speed, for which service the constant-speed type of motor should be used. Other types of tools call for a cycle of duties, in which the range of speed may vary almost from minimum to maximum conditions. In these cases the adjustable-speed type of motor should be used for the greatest economy. There are, therefore, in a single shop two distinct service conditions calling for different types of motors, different methods of applying the motors to the tools, and different methods of control.

Where direct current is available, these conditions can be met by the direct-current motor, that is, both a constant-speed and an adjustable-speed motor is available for machine-tool work. On the other hand, the alternating-current motor is essentially a constant-speed machine. At the present time no commercial method has been found for varying the speed of an alternating-current motor in such a way that it can be successfully used for machine-tool service. Thus it is apparent that the machine-tool designer must take into account not only the application of the motor to the tool, but also the class of current supply available in the manufacturing establishment in which the tool is to be used.

An alternative method of driving is by the use of a system of gears, commonly called a gear box, driven by a single belt considerably larger than that ordinarily employed on cone pulleys. This large belt will to a considerable extent furnish the power required, the necessary changes in speed being obtained by changing the gears. Obviously, however, a gear-box arrangement cannot be as convenient of manipulation as a motor controller, which can be mounted in a position to be easily reached by the operator. In addition to this difference between the two methods of changing speeds, the motor drive offers finer gradations of speed; that is, if the same results were obtained in a gear box, the multiplicity of gears would be considerable, and the up-keep a matter to cause serious consideration.

Standardization of Tool Equipments

One of the great drawbacks to a harmonious design of motor and tool has been the lack of a proper understanding of the joint problems of the motor and tool builder, this condition showing the necessity of some standard in respect to speeds or speed ratios, method of control, and certain dimensions of the motor or its adaptation to the tool. There is also a lack of standardization of the method of supplying power in industrial plants. For instance, there are so-called different systems, as direct current of 110, 220 and 500 volts, and alternating current of 220, 440 and 550 volts and two or three phases; also either 25 or 60 cycles may be called for.

In view of the above conditions, which are in a measure arbitrary, the future development of the art will be materially benefited if some standardization can be adopted by the tool builder and the motor builder, whereby they may be able to recommend certain standard power equipments for metal-working establishments.

Standardization to Accord with Central Station Service

Central-station power companies now realize the great advantage of a day load and are quoting low power rates to manufacturing establishments. It seems probable that in the future much of the power for small, and to some extent for large, manufacturing establishments will be furnished by central power companies, either those which are formed for the purpose of furnishing power only, or those which are regularly organized as public utility companies, furnishing both power and light. To this latter type of existing central power stations the day load supported by power service to manufacturing establishments is particularly attractive.

As most communities contain both manufacturing plants and central station companies, we look forward to an immense development of central power service, to be used by large manufacturers as well as by the smaller ones. For this reason we suggest that the class of service, that is, the characteristics of the current, should be taken into account when making standards for the operation of metal-working tools.

The steam railroad companies as a class have been to a considerable extent the largest single purchasers of machine tools, and it is well to consider the power requirements of such classes of purchasers when deciding upon a standard of motor equipments for tools.

For some years it has been the almost universal practice of steam railroad companies to install alternating-current generator equipment in their power stations; these are principally of the turbine type, largely for the reason that their requirements are to a considerable extent similar to those of the central stations of power companies. They are called upon to distribute current for lighting their train sheds, stations and yards, and power for operating turn-tables, transfer tables, etc., and for the operation of their repair shops, which usually consist of machine and wood-working divisions. Because of the simplicity and the great desirability of alternating-current motors, the railroad companies have adopted them almost exclusively for constant-speed service, as exemplified in the machinery of their wood shops, and for miscellaneous power purposes, such as pumping, operation of fans, driving incidental sections of line-shafting for supplying power to the smallest types of tools, on which it would be inadvisable to employ individual motors, and to tools requiring constant-speed motors.

For tools whose operation calls for adjustable speed, the standard practice is to employ direct-current adjustable-speed motors, using a controller conveniently located to the operator in such a way that the variation from minimum to maximum speed can be made with great facility, therefore affording a ready means of obtaining the maximum output for which the tool is designed.

It will be evident from this practice that two kinds of current are employed—alternating current for the primary and direct current for all secondary operations. To transform from alternating current to direct current, either a rotary converter or a motor-generator set is employed, the specific selection of one or the other depending somewhat upon local conditions and the class of supervision available for the operation of the outfit.

The same scheme of operation can be very advantageously employed when using central station service for the operation of machine shops or metal-working establishments in which machine tools are employed. Such a standardization of tool equipments by the tool builders and the motor manufacturers would tend to place the operation of metal-working tools on a more economic basis, in that it would enable better tool equipments to be designed with a definite certainty that the motor requirements could be forecasted. As it is now, a very considerable risk is involved in designing tools in advance of orders. Few companies manufacture motor-driven tools in large quantities and the public is thus called upon

*Condensed from *Journal* American Society of Mechanical Engineers, from paper presented by Charles Robbins, with Westinghouse Electric and Manufacturing Company, East Pittsburg, Penn.

to pay a higher price because of a lack of standardization.

On account of the fixed conditions of central station service, it is almost universal for the service to be 60-cycle, 3-phase, and as the transmission line is of relatively high voltage, transformers will be necessary at each industrial plant, and the voltage of the motor installation can thus be suited to the requirements. In metal-working establishments, where the motors can be located on the tools, or to some extent in close proximity to the metal structure, it is desirable to use a relatively low potential, say 220 or 440 volts. Thus in a measure there has been established automatically a standard for alternating-current service, consisting of 60-cycle, 3-phase, 220-440-volt, this standard being that used by most of the largest single purchasers of metal-working tools, that is, the steam railroad companies.

By the adoption of standards which conform with the central-station supply service, it is evident that even in the case of very large manufacturers who have their own isolated power plants, use can be made of a so called break-down connection with the central-station power company, as an extra precaution to insure continuity of service. This break-down connection can be made available only when the service supply is uniform with that employed by the isolated plant. Connection to a central power company would prove a very great advantage to a manufacturer for overtime work, when but little power is usually required, or under conditions when but a small percentage of tools are in operation as it would permit closing down the isolated plant, and the operation of the limited service from the outside power system.

This standardization of tool equipments would also enable existing manufacturing plants not equipped throughout for electric driving, but requiring the service of machine tools, to make trial installations of motor-driven tools or of a rapid-production tool, in which much of the advantage to be gained is due to the motor drive.

Analysis of Operating Conditions

It is only recently that data have been available to show beyond doubt the intermittent operation of the average machine tool. When a machine shop is driven by a belt from engine to lineshaft, and from lineshaft to machine tool, it is difficult to determine with any degree of exactness the length of time any particular tool is in operation, or the average time of operation during the working day.

With the installation of motors on lineshafts, it became evident that the total horsepower capacity of motors was much in excess of the power generated in the power station. The ratio is sometimes three to one, other times possible four to one.

As individually driven tools are adopted, it is noticed that the total horsepower capacity of all the motors connected to the service grows very rapidly, and that the ratio of the connected capacity to the power supplied is often as high as five or six to one, indicating that the time-load factor of the average machine tool is relatively low.

This apparent difference between the connected capacity of motors and the demand on the power station has led to a careful analysis on the part of the motor builders to determine exactly the length of time tools can be expected to be in operation.

An analysis which took into account the time of loading, cutting, unloading, and other delays occasioned by miscellaneous causes, showed conclusively that it was not necessary to use a continuously rated motor; in fact, an intermittent rating on the motor for a period not exceeding two hours' continuous service answers for almost all kinds of machine-tool applications. This knowledge enabled the motor manufacturer to build a more economical motor, one of smaller size, and consequently reduce the expense of applying motors to machine tools. The present-day tool equipment ought not, therefore, to be much more expensive, if any, than that of the belt-driven tool, when the cost of belting, shafting and power-house equipment is considered.

When machine tools are equipped with individual motors, a graphic recording meter may be connected in the motor circuit, making it possible to have a complete log of the operation of the particular tool during its time of service. The chart furnished by the graphic meter will show the time of loading and unloading the tool, the time of cutting, all delays due to stoppage for one cause or another and the amount of power to operate the tool, which is a direct function of the work done.

[An article describing and illustrating the use of a Westinghouse graphic recording meter for this purpose appeared in Volume 32, part 2, page 851.—Ed.]

The Economics of Motor Drive as Determined by the Actual Performance of the Tools

The economy of the individual motor drive, due to the fact that practically the exact cutting speed can be obtained for any operation, has been pointed out. This economy is not so important, however, as that of keeping a tool in continuous operation through longer periods of time, by reducing the time required for handling and other avoidable delays, as previously mentioned.

The accepted method of capitalizing motor drives seems in general to be on the basis of the incidental savings in the workman's time. In our opinion this is not the whole story by any means. When determining the monetary advantage of motor drive, the value of time saving should be considered on the basis of its effect on the total cost, which includes the workman's labor and the investment cost per hour of the tool.

In addition to workmen's wages, every shop has the following expenses:

(*a*) Interest and depreciation on cost of buildings and accessories.

(*b*) Repairs and renewals to existing equipment.

(*c*) General operating expenses, including losses due to defective workmanship, design and material.

(*d*) Salaries of supervisors, engineering staff and clerks.

These overhead charges must be included in the cost of any manufactured article. A method frequently employed is to determine from time to time the percentage which the total overhead charge bears to the cost of total actual or productive labor. This percentage in large shops reaches from 100 to 200 per cent., or even more. The total labor charge is then obtained by multiplying the actual labor cost by one, plus the per cent. to be added for the overhead charge.

This is an easy way to take care of the overhead charge; but the method is inaccurate and does not show the relative importance of different types and sizes of machines. This statement is especially true where a great variety of materials is manufactured, in shops using a large number of different types and sizes of tools. Under such conditions, the percentage obviously varies within wide limits for different kinds of work.

A satisfactory method of distribution is to set off against each tool its proportion of the total overhead charges. The portion chargeable to each tool depends entirely on local conditions; and thorough familiarity with these conditions is needed in order to apportion these charges equitably. In this way the relative importance of each machine is taken care of.

In a shop where only one type of article is manufactured and the castings are passed from one machine directly to the next, a simple and logical way is to divide overhead charge among the tools in proportion to the floor space charged to each tool. In the majority of shops, however, the above simple condition does not exist; several sizes and kinds of articles are usually turned out, and various sizes and types of tools, differing greatly in their operating characteristics, are employed. In such cases, not only must the floor space be considered, but also the time each tool is actually in operation, the nature of the work and the amount of supervision and engineering attention needed.

Large shops handling different classes of materials are in most cases divided into various departments or sections, and

each section may be considered as a separate smaller factory. The overhead charges against each department may thus be apportioned among its tools in proportion to the floor space occupied, making proper allowance for special local conditions, or special supervision or engineering attention. Here again is required thorough familiarity with both the engineering and the shop features of the materials manufactured.

In our experience we have found the overhead charges to be approximately as follows: Variable charges, from 50 to 55 per cent.; salaries, from 25 to 30; interest on cost of machine tools, from 5 to 10; depreciation on cost of machine tools, from 5 to 10; fixed charges, 3; power, from 1 to 2 per cent.

Item.	Lineshaft Drive.	Individual Motor Drive.	Advantage of Individual Motor.
1 Power consumption.....	Constant friction loss in shafts, belts and motor, power for cutting	Friction loss (motor and tool only); useful power only while working	Less power required
2 Speed control.....	No. speeds = no. cone pulleys × no. gear ratios	No. speeds = no. controller points × no. gear ratios	More speeds possible; time saved in speed adjustments
3 Reversing.....	Clutch and crossed belt	Reversible controller	Time saved in reversing
4 Adjusting tool and work..	Stopping at any definite point, very difficult	Can be started in either direction and stopped promptly at any point	Time saved in setting up and lining up
5 Speed adjustment.....	Large speed-increments between pulley steps	Small speed-increments between controller steps	Time saved by obtaining proper cutting speed
6 Size of cut.....	Limited by slipping belt; large belts hard to shift	Limited by strength of tool and size of motor	Time saved by taking heavier cuts
7 Time to complete a job...	.....	.....	Much less time required as indicated for previous items
8 Liability to accidents....	Slipping or breaking belts; injury to machine tool; cutting tool or prime mover	Injury to machine tool, cutting tool or motor	Much less liability to accidents
9 Checking economy of operations.....	Close supervision required; very difficult to locate causes of delay	Accurate tests possible by means of graphic meter which records automatically all delays and rate of cutting	Causes of delay and remedies easily located without personal supervision
10 Flexibility of location....	Location determined by shafting, and changes difficult	Location determined by sequence of operations; changes readily made	Greater convenience in handling and increased economy of operation; more compact arrangement possible

COMPARISON OF LINESHAFT DRIVE AND INDIVIDUAL MOTOR DRIVE FOR MACHINE TOOLS.

Definitions of Terms

In discussing the economics of motor drive there will be a number of terms used which are here given with our interpretation of their meaning.

Applied to the operation:

Time Factor = ratio of actual cutting time required to complete a machining operation

$$= \frac{\text{Actual cutting time}}{\text{Total time to complete operation}}$$

Applied to a Machine Tool:

Time factor in per cent. = $\frac{\text{Total daily actual cutting time in hours}}{\text{Total number working hours}} \times 100$

Average running load = average input to motor while operating, usually expressed in kilowatts, but may be expressed in per cent. of full-load input.

For rough calculations in this paper the input of a motor in kilowatts is assumed to be the same as the output in horsepower; that is, the motor efficiency in all cases is assumed to be about 75 per cent. This low percentage will take care of the fact that motors operate at light loads a considerable part of the time.

Maximum load = maximum input to motor, expressed in same terms as the average running load.

Average load = *Average daily load* = average input to motor during the total working hours; usually expressed in kilowatts. This load multiplied by the total number of working hours gives the total kilowatt hours consumed per day, and is basis of payment for energy. The average load multiplied by the number of hours per day and by the price per kilowatt-hour gives the cost of energy per day. The average load also equals the average running load multiplied by the time factor.

Load factor = the ratio in per cent. of the average daily load to full-load rating of the motor, or

$$\text{Load factor} = \frac{\text{Average daily load}}{\text{Full load rating of motor}}$$

Conditions Entering into the Operation of a Machine Tool

In order to obtain a maximum output from a machine tool, a careful analysis must be made of all the conditions entering into the operation of the tool. One method of doing this in the case of a motor-driven tool is to take power readings at frequent intervals and lay these out on a chart basis. Another and a much more convenient method is the employment of a suitable meter, as already described, designed to make a graphic curve, showing the exact condition occurring in the service when such a meter is applied to any motor-driven tool.

Summary of the Uses of the Graphic Recording Meter

By means of the graphic recording meter, the following improvements in shop management can be effected:

(*a*) If individual motors are used to drive machine tools, the exact percentage of total working hours consumed in actual cutting can be determined; it is found to average from 40 to 50 per cent., the maximum being as high as from 60 to 65 per cent. where the cut is of long duration; the minimum from 20 to 30 per cent. where jobs are short and the delay long in waiting for material, drawing, etc.

(*b*) The meter reveals all delays and suggests measures for eliminating those not essential and reducing all others to the minimum, thus materially increasing the time factor. All delays shown should be accounted for, and an attempt made to avoid them. Common delays are in assignment of the next job, in obtaining drawings, tools and other necessary materials, and in waiting for crane service.

(*c*) The rate of cutting indicated by the power consumption of motor-driven tools can be checked with a recording meter. The maximum rate is limited only by the nature of the work, the strength of the machine tool and of the cutting tool.

(*d*) The rate for maximum economy can be determined for different classes of work; and the records, considered as standard, can be compared with other operations of the same character to see whether the proper rates of cutting were used. In a finishing operation the rate depends upon the accuracy required. A record can be made while an expert machinist does the job, and this record should be referred to when other jobs of similar character are machined.

By the use of curve-drawing meters, and a careful study of the data obtained, the superintendent of a shop in which the individual motor-driven system is employed can set a limit fair both to employer and employees, for roughing, finishing, adjusting and setting-up. Different methods of doing the same job

can be compared to determine which is the most efficient.

The graphic meter need not be located near the machine to which it is connected, but may be placed in the foreman's office. Small leads connected to a shunt, or to a series transformer, according to whether direct current or alternating current is employed, are all the wiring required. The wiring can be so arranged that the connections of the meter can be readily transferred to any one of several tools; thus a single meter can be made to serve a group, or any number of tools, depending somewhat upon the frequency with which the records are required.

So far we have dealt chiefly with the time required to do machining operation, time being a most important consideration with shop managers and those who use machine tools. The power consumption, however, is also of some importance, especially to those requiring motors for machine-tool operation.

Relative Economy of Lineshaft Drive and Individual Motor Drive

An increase in economy of operation of manufacturing machinery can be effected in two ways: first, by reducing the power required to operate the machinery, by saving of friction load, etc.; second, by reducing the time required for a given operation, or, in other words, increasing the output in a given time. When confronted with the problem of deciding between the continued use of an existing lineshaft drive, or an individual motor drive, or when deciding between the two methods for a new installation, the problem should be considered in all its phases, as outlined in the accompanying table. This table includes every important item to be considered, except one; and in every case the advantage is with the motor.

Comparing the first cost is possibly the first consideration to enter the mind of most men, and this is the one consideration omitted from table. That this consideration is relatively of minor importance will be evident, when the saving in power consumption, and in time, made possible by individual motors, has been considered.

Selection of Motor and Tool Equipment

In the selection of a motor-driven tool, there are certain features which should be taken into account and properly analyzed, and specifications drawn to cover them. If a tool is for specialized manufacturing, there should be specified:

(*a*) The exact class of work which the tool is to accomplish.

(*b*) If the power required to remove the metal is not known, then a statement should be made as to the approximate feed and cutting speeds to be taken.

(*c*) Careful analysis should be made of the time required to load and unload the machine, to determine the feasibility of employing auxiliary means other than manual labor for loading the tools.

(*d*) From this information, an approximate determination can be made as to the intermittency of operation of the tool, in order to decide whether an intermittently rated motor or a continuously rated motor will be required.

(*e*) By a knowledge of the physical shape of the work, determination can be made as to whether an adjustable-speed motor will result in economy of time, if used on this particular class of tool.

(*f*) Will enable the tool builder to determine upon the proper type of controller, and its most desirable location from an operating point of view for the workman.

If a special type of tool is not desired and it is preferable to purchase one with such characteristics that it can be used for general manufacturing, one should determine as nearly as possible the range of material or work for which it will be used in straight manufacturing operations. A knowledge of this will undoubtedly permit of a better motor and tool selection, than the simple purchase of a standard stock tool.

It should be realized that under present schemes of operation few tools are in operation more than 50 to 60 per cent. of the time, whereas, the load factor of those tools may be as low as from 10 to 40 per cent. Thus we have it brought home to us clearly that much of the time the tool is in idleness and is often operated much less than its maximum capacity.

The direct-current motors are built for speed adjustment over a range of 1 to 2, 1 to 3, and in some instances 1 to 4. With the proper selection of controller the speed adjustments may be made in small increments of from 10 to 15 per cent., and since these small increments of speed adjustment are available, it is essential that a controller be selected of such type that it can be mounted conveniently to the operator, so that he may take full advantage of them.

Where it is necessary to employ the alternating-current motor, it may be absolutely essential to employ a gear box to obtain the various speed adjustments. When such a machine is employed, the fine graduation of speed obtainable with a direct-current adjustable speed motor is absent, and the gear box will practically take the place of the ordinary cone-pulley arrangement. It has, however, one advantage when motor-driven, and that is, that the tool is supplied with positive power at all times, and will take care of the maximum conditions without slipping or loss of power, which frequently occurs when belt drive is used. In some instances it has been found possible to make good use of the so called multi-speed alternating-current motor. This form of motor consists in certain different types of windings, permitting of a multiple method of pole grouping, such as for instance, a speed of 1800, 1200, 900 and 720 revolutions per minute, according to the method of winding the motor. In some cases, this type of constant-speed motor, when used in conjunction with a gear box, will permit of somewhat finer graduations of speed than are possible with a constant-speed alternating-current motor and a standard gear box.

While it is apparent that with the constant-speed motor all of the advantages of the adjustable-speed motor cannot be obtained, a tool equipped with either type has the advantage to be derived from the ability to obtain a graphic log of the time of operation of the tool. With either type, in combination with a graphic-recording meter, a distinct gain can be made over a belt-driven tool from which such graphic curves cannot be conveniently obtained.

There are segregated charges, which must in some manner be taken into account in determining the cost of a machine-tool hour, not only including the workman's time, but also the actual expense to a manufacturing establishment of having a tool equipped and ready to be used when the workman requires the services of such tool. The range of the tool-hour rate is far in excess of the labor rate for a tool; consequently, any time which can be saved in keeping the tool in its maximum productive capacity will far outweigh any saving that can be made in the actual labor account. It is this one feature in which the motor-driven tool in combination with the graphic recording meter is destined largely to decrease the cost of machining operations when the records available by this combination are carefully studied and proper remedies applied.

General Conclusions

The economical operation of a machine shop requires a thorough analysis of all the operating costs; that is, overhead and operating charges of all kinds, and an accurate knowledge of the operating conditions of all machine tools. Investigations of these conditions must be conducted by someone familiar with both the engineering and the shop features of the apparatus manufactured. The investigator should also be familiar with the characteristics of the various types of motors and methods of control, in order that the most advantageous electrical equipment as well as the best machine-tool equipment may be installed, with suitable tools for different sets of conditions.

Such investigations lead to the following improvements which result in increased productive capacity:

(*a*) More flexible arrangement of tools.

(*b*) Greater facilities for handling materials at the tools.

(*c*) Greater facilities for handling materials between tools.

(*d*) Better facilities for obtaining auxiliary material, drawings, tools, etc.

(*e*) Better facilities for making adjustment of the tools during machinery operation.

(*f*) Removal of causes of unsuspected or avoidable delays due to small accidents and improper characteristics of the drive.

(*g*) All lost time, due to whatever cause, and which can be avoided, is immediately brought to the attention of the superintendent, and an analysis of these losses will result in their elimination.

With motor-driven tools this analysis can be made much more conveniently and with less expense than can similar studies with any other form of machine-tool drive.

While in many shops there are elaborate systems of time keeping, with time clocks, etc., all of which are based on keeping an exact record of the workman's time and seeing that he works the maximum or full shop time, yet the most important consideration in manufacturing with machine tools is that the tools shall operate their full capacity, on account of their greater hourly value.

In comment on this conclusion it may be said that our tests have not been confined to metal-working tools, etc. We have found similar conditions in the wood-working industries, to some extent in cement mills, steel mills, brass- and copper-rolling mills, to a less extent in the textile mills, where it is a supposition that every machine is running the maximum number of hours, and at its maximum load at all times; and in several minor industries, in which the information therein contained is no less important, even though it might be different than that obtained with machine tools or metal-working tools, as ordinarily installed.

Certain it is, that a careful analysis and study of conditions which are conveniently possible in motor-driven establishments will greatly reduce the cost of operation, and it seems reasonable to suppose that the methods herein illustrated may serve some useful purpose if the data will arouse an interest on behalf of those present.

We know that wherever the tests have been made, the conditions of operation have been very materially benefited, and feel without question of a doubt that many dollars have been saved on account of the knowledge shown by a simple record taken from motor-driven machines, which records are available to all those who have these meters.

[An appendix gives a number of valuable data pertinent to the subject and these will be reprinted in other columns. —EDITOR.]

Two Special Riveting Devices

Editorial Correspondence

In Fig. 1 is shown a special machine designed and constructed at the Sirocco plant of the American Blower Company, at Green Island, N. Y. The call for this machine is due to the necessity for riveting the very small sizes of blower runners, one of which is shown in the illustration, as gripped between the jaws of the riveter. This little runner is not more than 4 inches in diameter, and the problem of getting the very small rivets in, with the very restricted space between the runner blades, was a difficult one, requiring rather delicate finger work. By means of the machine illustrated, however, this operation is much simplified.

As shown, an eccentric controlled by a bell-crank lever, slides on the main shaft so as to engage and force down the horizontal lever extending back from the lower riveter jaw. This jaw is so made that it fits in between the runner blades and so grips the rivet, squeezing it down in place.

In Fig. 2 is shown what might be characterized as a crystallized form of the more or less familiar wooden block and bar or lever, often used for backing up rivets while being driven. As the company above mentioned has considerable of this work to do, they came to the conclusion that it would be economy to have some such device as this, neatly and strongly made, which would be much more easily handled than is the usual makeshift. It consists of a wooden bar with a rocker end, upon which is hinged a vertical, iron, backing-up bar, to support the plates and the rivet. While not startling in its nature, it appears to be a rather neat idea. There are several of them in use at this plant.

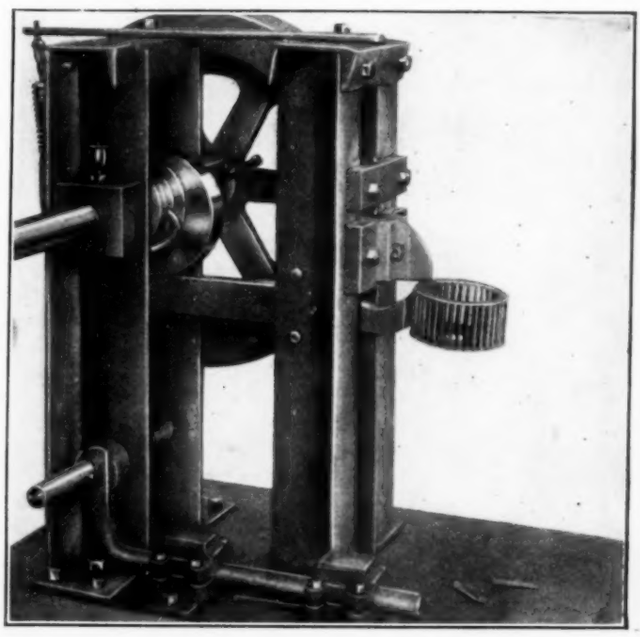


FIG. 1. A RIVETING MACHINE FOR CLOSE QUARTERS

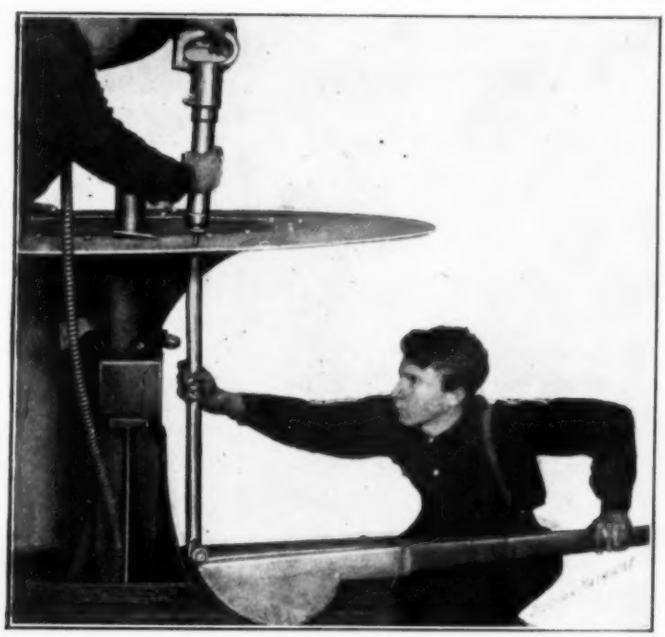


FIG. 2. A NOVEL "HOLDER ON"

The Inventor as a Business Man

By Samuel L. Platt

"There's only one thing in the whole matter not just to my liking; that is, the money is to be put up in instalments instead of one payment. I wanted those bank fellows, who have always been stuck up and afraid to trust me, to see that there are men who are willing to give me some show." Thus said the inventor as he was relating to his friend the details of getting the company started to manufacture his invention. Having been given 51 per cent. of the stock for his invention, been made president and general manager of the company and his brother-in-law treasurer, it seemed as though the inventor had little to complain of, because the money was to be put up as needed instead of in one lump sum a large share of which would lie idle in the bank for some time. Yet this made him foolishly wonder if the stockholders were a little afraid of him the same as the bank people seemed to be. "I will just keep my eye on things and see," he said.

Like a small piece of steel in one's eye this little circumstance kept irritating the inventor. The more he thought about it the more he became convinced that one thing indicated something held back, something hidden. People generally find what they are looking for, especially when it is trouble. One of the directors suggested that during the time of getting things started, letting contracts, etc., meetings be held oftener than the by-laws called for. This at once aroused the inventor. In it he saw what he thought was a curtailment of his power. A discussion ensued and when the inventor discovered that the directors wanted to approve these contracts before they were let, as is customary, he became very provoked. Thus started, at the very beginning, a feeling of unpleasantness.

Getting Even

The more he dwelt on it the more the inventor became determined to get even with the directors for sticking their noses in his affairs, as he put it. At the first meeting, not knowing what the directors wanted, the inventor spoke of the figures received for erecting the building. The directors, in the customary way, approved the contract without realizing the inventor's idea of running things himself. When it came to letting the contracts for boilers, engine, etc., without saying a word or consulting the directors, he signed them. And further to show them his authority he chose the most expensive outfits offered. At the following meeting, held in the office of one of the directors, the inventor was absent, claiming he was too busy at the shop (?)—watching the masons and carpenters.

Different directors from time to time visited the new building to see how things were progressing; but as each one was pretty thoroughly snubbed by the inventor, the visits soon stopped. No mention was made of this treatment, each supposing he was, in some way the offender and did not care to speak of it. The inventor did not attend the third meeting and as this made it impossible to do anything the directors decided to visit the shop in a body, just to see how things were getting on, each with the intention of watching to see how the others were treated by the inventor. Arriving at the building it was quite awhile before they could locate the inventor, he having seen them first and purposely kept out of their way. This gave them a good opportunity of seeing the boilers and settings being made ready, the engine foundation with the bed on it, for which, as far as they knew, no contract had been placed. This was quite a surprise to them and when mentioned to the inventor, he, in considerable anger told them he proposed to have things as he wanted, he knew what was needed and they didn't. Being taken off their feet the directors left and returned to their meeting place. The talk that followed soon revealed the treatment received by the directors individually and even though they were pretty mad they tried to excuse him by considering the many details that had to be looked after, and selected one of their number, noted for his diplomacy to try and reason with the inventor. Waiting a few days to give things a chance to blow over, the peace-maker director made a visit to the shop. Instead of blowing over, these days seemed to have fanned the flame. The inventor was even more abusive than before, words followed words until both became pretty hot, and the ill feeling increased.

A New Board of Directors

The directors held an informal meeting but could not devise any way of getting matters straightened, so they appealed to a friend of the inventor to see if he could get him to realize that they were not doing more than is customary and had no ill feeling whatever. This proceeding only made matters worse. The inventor requested the secretary to call a meeting stating that he wanted to have the directors discharged and a new board elected. When the inventor's lawyer heard of this, he had a most stormy interview with him, trying to explain that they were elected for a year and could not be dismissed in any such summary way as he proposed, without cause or a lawsuit. It made the inventor very provoked to think that he could not get rid of them even with his control of the stock that he resorted to further extravagant ways of showing them how he was going to do as he wanted, regardless. Many consultations among the directors finally brought them to the opinion that they had better resign and allow him to put in a new board, hoping this would stop his extravagance and bring him to reason. The new directors were coached regarding conditions and for a while kept matters going a little better, but a thoughtless word by one of them aroused the same ill feeling, and a worse state of affairs developed.

It became necessary to call for the third instalment of the stock subscription before the time set, and a very little figuring showed that the entire amount would not be sufficient to finish the shop and its equipment, to say nothing of the working funds needed and estimated on. The dilemma was a real one. Informal meetings were held and ways and means discussed. The inventor was sounded by friends and salesmen but he still held to his methods. When he was told that unless arrangements could be made to get more money, the concern would have to face bankruptcy before it could get started, he only replied, "let her go, then."

Other Plans

When the funds actually ran low, the inventor, knowing other concerns got accommodation at the banks, supposed, of course, that he could do the same. The bankers, knowing how things were, were afraid to loan him. He next tried placing a mortgage on the plant, but found that he could not get the necessary two-thirds vote. By this time the inventor was very nearly crazy and his appeals to former directors and stockholders brought much the same treatment he had given them. Realizing fully that the inventor was not and probably never would be one to depend on, the stockholders had gotten hold of a man with a good business and manufacturing training and made up their minds to have a receiver appointed, a reorganization effected and the new man put in place of the inventor. When the receiver was appointed, the inventor being still mad clean through, tried to sell his stock. Meeting with a ready sale for part of it, he supposed it was going to be easy to sell it all, but after the first lot, which took the control out of his hands, he could not find another buyer.

The reorganization with an increase of capital left the inventor out entirely. He was not even made a director. The invention had passed over to the company and all the inventor had was a block of stock in a company, named after himself, controlled by men that he had made enemies of by his own actions.

Thus was another chapter of history made and another story added to the many of how the "poor inventor" has his invention taken away from him; yet, as in many cases, it was not stolen for he threw it away himself just because he would not listen to reason, and could not put all that money in the bank in one lump sum, to satisfy his vanity.

Principles of Thread Rolling and the Setting of the Dies

Determining Pitch, Angle of Thread and Position of the Dies

By J. F. Springer

As far back as 1851 there was exhibited in the South Kensington Museum in England a machine for rolling screw threads. The thread is produced by rolling the work between two plane dies and this same basic idea is still retained in certain modern machines.

In order to understand the principles involved, consider for a moment the character of the screw thread. It is a projection inclined to the axis of the screw and wound around in the form of a simple helix or conical helix. By cutting a rather oblong sheet of paper along one of its diagonals and then wrapping one of the halves about a lead pencil in such way as to keep the longer side of the original rectangular sheet always flush with the end of the pencil, we shall have transformed the ordinary inclined plane of the diagonal into a conical modification. This is not, precisely, what we have in the screw thread formed on a cylindrical bolt, but it approximates it. The paper thread discloses loops whose radii at every turn increase or decrease, depending upon whether we follow it one way or the other. In the cylindrical screw thread there is no such variation. The thread of a gimlet-pointed screw is, however, a kind of conical helix, the radius of curvature diminishing to zero. If the paper had possessed no thickness at all, we should have had a helix of uniform curvature traced out by its inclined edge. This is precisely what we have in the case of a screw thread formed on a cylindrical surface.

Of course, we cannot get paper without thickness; but we can get our trace just the same by so managing the paper as never to suffer it to warp upon itself. Suppose we begin at the top and work downward. All we have to do, then, as we go on folding is to let the vertical edge of the paper go before we have wrapped around a full turn. Further—suppose that instead of a flexible sheet of paper we use a stiff one of metal. Performing a similar action we shall get the trace of our thread and will not have to be careful to avoid overlapping, the stiffness of the sheet of metal effectually preventing such action. Still further—suppose, instead of performing this action of stiff winding, we should roll the pencil on the metal sheet. The result will be the same. Or, we may lay the pencil on a plane surface, place the metal sheet in correct position above, and then get the relative movement of the pencil rolling against it by pressing and pushing the sheet along.

Action of a Thread Rolling Die

Suppose, instead of a metal sheet of the form described, we use a rectangular die having a V-shaped ridge for one of the diagonals. Holding this continually in a proper position, we may press and push as before and get a groove of a screw thread form. Or, we may lay the die

FIG. 1. ROLLING A CYLINDER OVER A DIAGONAL RIDGE

down and roll the bolt blank across its face with the same result. By either procedure, we get the proper screw-thread groove. It is important to note that the die which will produce a right-hand helix when pushed along will when turned over and the blank rolled upon it yield the same right-hand thread. This suggests that we might perform both operations simultaneously. And so we might. For, by arranging the blank as shown in Fig. 1, lying on a die and ready to be rolled, we may roll the blank along for half a turn using the lower die alone. This half-turn has, however, brought the groove to the highest point. We may now introduce the duplicate die and perform the rolling by means of it. The two dies are now forming precisely the same groove. The influence of each is felt a half-turn after that of the other. We see now that the correct relative positions of the two duplicate dies at the moment when the action of the second one begins is such that there is an overlap of one-half turn.

Suppose now instead of rolling the blank bolt along on the under die for the amount of the overlap by means of a blank die above, we cut away the ridge on the lower die, and so leave it blank, for the distance of one or more half-turns. A blank bolt may now be placed on this smooth surface close up against the beginning of the ridge. If now the upper die be given its forward motion, the relation between the two dies and the ungrooved bolt will be that shown in Fig. 2 at the moment when both dies are at the beginning of their work. As the bolt rolls under one and over the other, both dies will trace out the same groove—the one continuing the action of the other.

Now this coöperation between the two dies could have been secured in another way. Suppose two duplicate dies and the bolt blank to be in the position shown in Fig. 3. If rolling begins now, the groove formed by the one will not coalesce with that formed by the other. For with screw threads grooves do not lie at the opposite ends of a diameter. But that is just what the dies in Fig. 3 will begin to form if rolling should begin. The proper relation is that the groove at one end of a diameter should be one-half the pitch distant, measuring in the direction of the axis. Now this relation may easily be obtained by displacing one of the dies along the bolt axis a distance equal to one-half the pitch, or, any odd number of intervals each equal to one-half the pitch.

Of course, a combination of the two methods of securing coöperation between the two dies may be adopted. It is important to bear in mind, however, that the adjustment to secure coöperation must be exact. Otherwise, the work of one die will not perfectly coalesce with that of the other.

Suppose now—considering one die alone for the sake of simplicity—other ridges be arranged on the die face, all parallel with the original one and at precisely the same distance of the pitch from each other, measuring along the axis of the bolt. Then, as the rolling goes on, the groove made by one ridge is taken up by an adjacent ridge as soon as a full turn is made. With both dies formed thus, there is a very complete action on the blank. Of course, one die is sufficient to form the groove. The bolt must be supported, however, and this must be accomplished without destroying the threads in process of formation.

Now the grooving process operates, as we have seen, to force up metal upon either side of a groove. Two adjacent

grooves would thus give rise to a considerable ridge between them. In fact, the amount of metal in the ridge would just about equal that displaced from one groove. By properly shaping the face of the die, grooves and threads of various forms may be made.

It was in accordance with these principles that the ancient machine exhibited in London nearly six decades ago operated. Two flat dies were used. One was held in a fixed position, while the bolt blank was rolled over it by another flat but moving die.

Forming the Faces of the Dies

Let us return, now, to a consideration of the die faces. These are duplicates, except for the cutting away of a portion of the one, as already explained. It is not necessary that any one of the cutting edges run from corner to corner of a rectangle. What is required is that the "threads" of the dies shall be properly formed and shall be at the proper distances from each other, also, that the inclination of these diagonal "threads" shall be exact. It is essential that when a complete turn of the blank has been made, the distance along the direction given by the bolt axis, between the beginning and end of a groove on the blank, shall be exactly the pitch selected. If we know the radius of this groove—that is, the length of a perpendicular from the groove to the axis of the bolt—then the inclination must be such as to correspond to a rise of one pitch in a horizontal distance of one circumference. Some builders regard the radius as that of the blank before rolling is begun.

Finding the Angle of Inclination

To illustrate—suppose that the radius of the blank is 0.078 inch, and that there are to be 32 threads per inch. The pitch is, consequently, 1/32 inch (0.03125 inch), and the circumference 0.49009 inch, so that the inclination will be such as to correspond to 0.03125 in a distance of 0.49009 inch. This is equivalent to 0.76393 inch in a foot. If we desire to know the angle, it is easy to determine it. For, denoting the angle by ϕ, we have at once,

$$Tan.\ \phi = \frac{0.03125}{0.49009} = 0.06377.$$

By referring to trigonometric tables, we find

$$\phi = 3\ degrees\ 39\ minutes.$$

In actually arranging for the cutting of the dies, the former method of stating the inclination as 0.76393 inch in a foot is probably more convenient.

Finding the "Thread Angle" for the Die and Pitch

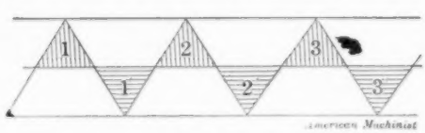
The dies are cut on the milling machine. A cutter is constructed with grooves and "threads" corresponding to those desired for the bolt or screw. These are, however, circular and not helical; for what is desired is a die whose face shall be scored in perfectly straight lines. The movement of the die under the milling cutter is rectilineal, and always perpendicular to the axis of the cutter. The "pitch" of the "threads" on the cutter and their cross-sectional form are, consequently, different from the corresponding features of the finished bolt or screw. The depth of groove and hight of thread

FIG. 2 FIG. 3

American Machinist.

Diagrams Illustrating the Setting of Thread Rolling Dies

are the same in both. But in the cutter the sectional triangle has a sharper vertex and a narrower base. On the assumption that the thread is a sharp "V" and that thread and groove are alike in section, we may proceed to determine the base of the triangular section of a cutter "thread." The "pitch" on the die is the same as the pitch on the bolt. That is to say, if there are 32 threads to an inch on the bolt, there will be 32 "threads" to an inch on the die if we measure the inch on the die along the direction given by the axis of the bolt when the bolt is in proper position for rolling. Now the axis of the cutter, and consequently a radial section of a "thread," is perpendicular to the line of direction of the "threads" and grooves on the die. So that the base of the triangle of a "thread" or the cutter is the *perpendicular* distance between two "threads" on the die. Denote the "pitch" in the die by p, and this perpendicular distance by x, and the angle between them by ϕ. Now p and ϕ



American Machinist.

Fig. 4. Diagram of Ridges and Grooves

are known, p being the same as the pitch of the desired thread and ϕ, the angle of inclination of the grooves on the die. Consequently, we have

$$\frac{x}{p} = cos.\ \phi.$$

From which we get

$$x = p\ cos.\ \phi.$$

Now let h equal the hight of the desired thread on the bolt. This is the depth of the groove on the die and the hight of a "thread" on the cutter. Let ξ be the angle at the vertex of a section of the cutter "thread." We have then,

$$Tan.\ \tfrac{1}{2}\xi = \frac{x/2}{h} = \frac{x}{2h}.$$

Substituting for x its value above, we get

$$Tan.\ \tfrac{1}{2}\xi = \frac{p\ cos.\ \phi}{2h}.$$

Since P, ϕ and h are all known, we may determine with the aid of a table of natural tangents the value of ½ By doubling the result, we will get the whole vertical angle.

Let us return to the case considered before, where it was desired to roll a thread of 0.03125-inch pitch on a blank whose diameter is 0.156 inch. We found that when it came to scoring the die, the angle of inclination ϕ would be 3 degrees 39 minutes. Assuming that the thread desired is one of 60 degrees, we have for h, since the triangular section is equilateral and its base is known,

$$\frac{h}{p} = cos.\ \tfrac{1}{2}(60°) = cos.\ 30° = 0.8660.$$

Therefore,

$$h = p\ (0.8660).$$

But

$p = 0.03125$ inch; therefore

$h = 0.03125 \times 0.8660 = 0.02706$ inch.

We now have the values of p, ϕ and h, and can consequently determine ½ξ from the formula formed a moment ago. That is,

$$Tan.\ \tfrac{1}{2}\xi = \frac{p\ cos.\ \phi}{2h} = \frac{0.03125 \times 0.9980.}{2 \times 0.02706}$$

$$Tan.\ \tfrac{1}{2}\xi = 0.5763.$$

From table

$$\tfrac{1}{2}\xi = 29\ degrees\ 57\ minutes.$$

Consequently,

$$\xi = 59\ degrees\ 54\ minutes.$$

The value of x (i.e., the perpendicular distance between "threads" on the cutter) is to be found from the formula

$$x = p\ cos.\ \phi.$$

Consequently, in the present case, we have

$x = 0.03125 \times 0.9980.$

$x = 0.031119$ *inch.*

This is the "pitch" of the cutter. We learn now that corresponding to the 60-degree threads desired, which have a pitch of 0.03125 inch, the cutter will have "threads" whose angle is a trifle less—59 degrees 54 minutes—and whose "pitch" is also a little less—0.03119 inch.

Relative Volumes of Corresponding Groove and Ridge

One characteristic of rolled threads is that the gage of the threads is greater than that of the blank. A little consideration will make clear the reason. As the ridges of the die press into the body of the blank, an equal volume of material is forced up between them, so that the volume of that portion of the groove within the gage of the blank is equal to the portion of the thread outside of it. In other words, if we should machine the finished threads down to the gage of the blank, the amount of metal thus removed would be just about sufficient to fill up the surviving portion of the grooves.

The question now arises whether or not the hight of the thread tops removed is equal to the depth of the groove bot-

toms left. Suppose we first deal with threads that are not screw threads at all, but circular ridges. In Fig. 4, we have a longitudinal section through these "threads." Let a horizontal line be drawn along the summits of the ridges and another through the bottoms of the grooves. Now draw a third horizontal line halfway between the others. If this last line be taken to represent an edge of the blank, we inquire whether the other two lines may represent the depth of the grooves and the hight of the "threads" due to a rolling procedure. The little triangles horizontally shaded represent metal displaced from within the original limits of the blank, while those vertically shaded represent extruded material. That is to say, 1′, 2′, 3′, etc., represent grooves rolled in, and 1, 2, 3, etc., represent ridges rolled out of the original blank.

The question reduces to this: Is such a groove equal in volume to such a ridge? It is quite evident that we may say of the little triangles that $1 = 1'$, $2 = 2'$, $3 = 3'$, etc. If the triangle 1 be rotated from the axis of the bolt, we shall thus generate an extruded ridge, and if 1′ be likewise rotated, we shall obtain the rolled-in groove. Further, what we may call the bases of those two rings (that is, the cylindrical bands) are equal in area. But the circular edges opposite these basal bands are not at all equal. In the one case, the edge is greater in circumference than the corresponding base; in the other, it is less. It will readily be granted, then, that the volume corresponding to triangle 1 is greater than that corresponding to the triangle 1′. We thus reach the conclusion that if the die rolls in just one-half of its depth, the amount of metal thus extruded will not be sufficient to form the "threads." Now, while this rough analysis is derived from a consideration of what are not true screw threads, it will be granted, no doubt, that practically the same reasoning applies to a comparison of a true helical thread with the corresponding groove. A die which penetrates but one-half of the depth of its face into the blank will not force out under such conditions sufficient metal to form the thread.

That is equivalent to saying that if perfect threads are rolled, the die must penetrate into the original blank more than one-half the depth of its face. In other words, the radial increase in rolling perfect threads on a blank is somewhat less than one-half the hight of an entire thread. Or, finally, the gage of the threaded portion is something less than the gage of the blank, plus the depth of a thread. For screws having V-shaped 60-degree threads and grooves the same, instead of deducting the hight of a whole thread from the desired gage of the screw thread in order to determine the gage of the necessary blank, we subtract the following percentages of the hight:

For screw threads whose gage is less than ⅛ inch, 64 per cent.; from ⅛ inch to 3/16 inch, 69 per cent.; from 3/16 inch to ¼ inch, 75 per cent.; from ¼ inch to, say, ¾ inch, 81 per cent.

Milling Cuts—Settling Accident Claims

By John R. Godfrey

We do not always realize the effect of the duration of a cut, either on the power required or the speed of the cutter. The power end is very well shown in the little sawing outfits that depend on a wheezy engine and a much patched belt to drive the saw. They run like mad without load and cut through light stuff at a good speed, but if the stock happens to be extra large, the belt makes music and the saw probably stops to rest.

I ran across a milling proposition the other day which acts in a similar way. The job was sawing the slots in castle nuts perhaps a ⅛-inch belt, so that the length of cut each side of the hole was pretty short. This was being done on a Whitney hand miller and the way the work was going under the cutter and the z-i-p of the cutter as it went through the work was an eye opener in the milling field. The cutter ran pretty fast, but it didn't sound as though more than one tooth hit the work.

It is quite probable that the cutter would have stood, or even done better, at a faster speed, but it is equally probable that it would not have stood at all with this feed had the cut been six or eight times as long.

If, however, this had been very hard stock, the cutter would have been toothless in a short time. This goes to show that while soft stock can be pushed off very rapidly, for hard stock a continuous cut at a fair feed is much better. All of which emphasizes the fact that a good crop of horse sense is necessary to use any rule or suggestion to the best advantage.

Settling an Accident Claim

I ran across a claim adjuster for a railroad the other day who possessed a rather novel plan. And, while it would not be approved by a company which was chasing the present dollar so hard that it couldn't see a five-spot ahead, it has its good points just the same.

Instead of coaxing or threatening the injured man or his wife or mother until they either signed a release or got mad and told him to go to ———, as is usually the case, his line of talk was something like this:

"We're both too much excited to think this thing out straight just now and I want to ask just one favor of you. It's as much for your sake as ours. *Don't sign any papers for anybody for 30 days.* In the meantime you will be taken care of and your doctor's bills paid whether you sue afterward or not. But take 30 days to think it over. Then I'll make you the best offer I can and you can take it or sue the company as you think best. But don't sign anything for me or anyone else, until you've thought it all over."

His plan is to try and provide for the future of the man if he is not entirely incapacitated, rather than to offer a large cash settlement and set him adrift. There may be a mercenary side to this, but a man is certainly better off with a thousand dollars and a job that will support him and his family, than five-thousand dollars and the usual slim chances of employment when a man is crippled.

I believe that we shall see more of this as we come to realize that the injuries belong to the industry and not the individual. For the manufacturer can shift the burden to the consumer, just as he is forced to do with his fire insurance and other overhead expenses. The worker can only shift it by demanding higher wages which is necessarily put on the consumer just the same.

Use of Steel in Locomotive and Car Construction

There has been considerable discussion during the past few years on this topic, and all-steel construction in railway equipment seems to be the order of the day.

In a bulletin of the International Railway Congress Association it is the conclusion of a paper on the use of steel in locomotive and car construction that the progress made in design and manufacture in steel of the various details of locomotives and cars, such as tubes, wheels, bolsters, truck frames and similar parts, indicates that further substitution of this material for wood, wrought and cast iron may be expected. While steels of special alloy or composition have been utilized in the building of railway rolling equipment, neither the quantity used nor the length of time in service is sufficient to warrant any expression as to the possible economy to be obtained by their use. The use of steel construction of railway rolling equipment has generally given advantageous results, both from a service and economic standpoint, as compared with the results obtained with the material for which it was substituted.

Letters *from* Practical Men
Concerning *the* Details *of* Making things *in* Machine shops, *from the* First Sketch *to the* Sale

A Novel Rack Drive

The rack and pinion illustrated by Fig. 1 has been used successfully on several machines which have now been operating for eight years. This rack and pinion presents some novel features, and is the result of a thorough investigation which I made in order to solve a perplexing problem in mechanical movements.

In one machine there are upward of 500 pinions moving along in an approximately horizontal direction. During their travel each pinion at regular intervals meets eight different racks alternately above and below the pinion. As it approaches each rack the pinion may be revolving forward, backward, or standing still. The pressure on the pinion while engaging and disengaging with these racks, is approximately 4000 pounds; showing that the work required of it is not light. The motion, fortunately, is slow, namely 10 feet per minute.

While the racks and pinions produce the required movement in the most satisfactory manner, they were for a long time rejected from consideration in the design of the machine, as it was believed to be impossible to make a pinion always engage properly with a rack at each approach. I felt confident, however, that this could be done, and the result of my efforts is embodied in the accompanying drawing. I feel that it may be of value to your readers who may be confronted by a similar problem.

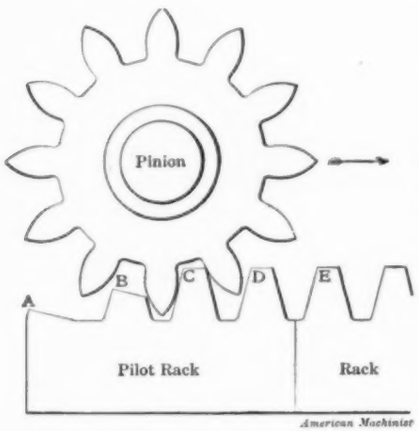


FIG. 1. SHOWING PLOT RACK

In getting at this result, I came to the conclusion that if both the pinion and the rack had quite sharp points of approach, that it would be next to impossible to come in contact in such a way that binding would result. I pictured to myself a man taking in each hand a sharp-pointed stake and trying to thrust the two points mutually at each other and make them catch on the ends.

You will note on the drawing that the regular teeth on each rack are preceded by two deformed teeth which I prefer to call pilot teeth. The first one is very low and brought to a sharp, almost knife edge. The second tooth is the same shape as a rack tooth, but only half the regular hight. The third tooth and following are regular-shaped teeth, such as would be used in any tooth system.

The teeth on the pinion are regular involute teeth in their outline, except that the extension which brings them to a point is carried out on the same regular curve.

The pinions are all made of cast iron. The racks are also made of cast iron, but a length of 12 inches in front of each is made of tool steel hardened in oil. It is necessary to have these pilot teeth very hard, as they show a strong tendency to wear away.

The action of engagement is as follows: The tooth *A* being very low, just sufficiently high to catch about ⅛ inch of the point of the tooth on the pinion, reaches well underneath and catches the pinion at a favorable point to produce rotation. If it catches a tooth it will always turn the pinion in such a position that the following tooth must engage. If, however, it fails to catch a tooth on the pinion, the pinion is bound to be in such a position that the tooth *B* will strike in a favorable position and rotate the pinion in such a manner that the following teeth must engage.

The exact method of laying out these teeth can hardly follow any fixed rule, but they would have to be laid out by trial to suit each particular case.

C. S. SHUMAN.

Philadelphia, Penn.

Laying Out Angles without a Protractor

It often becomes necessary in the tool room and sometimes in other parts of the shop, to lay out an angle of a given number of degrees, or occasionally as fine as degrees and minutes and while this is an easy matter with a good protractor, this instrument is not always available. The method herein described will, however, enable anyone to lay out any prescribed angle with accuracy.

For example we will suppose that in Fig. 1 it is desired to lay out the line *O C* at an angle of 20 degrees with the horizontal line *D D*, from point *O*.

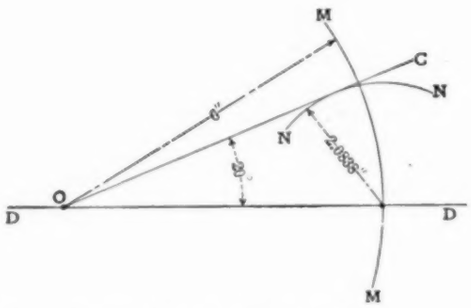


FIG. 1. LAYING OFF AN ANGLE WITHOUT A PROTRACTOR

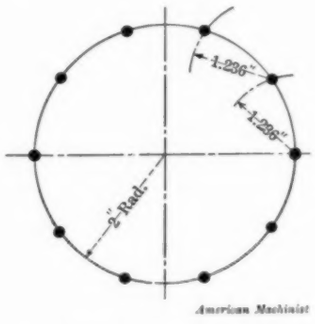


FIG. 2. SPACING BOLT HOLES WITHOUT A PROTRACTOR

Set an ordinary pair of dividers at any convenient radius, which in this case we will take as 6 inches and, placing one leg of the dividers on the point *O*, strike the arc *M M*. Then, placing the leg of the dividers at the point where the arc *M M* intersects the line *D D* and, with the dividers set to a radius equal to the first assumed radius multiplied by twice the sine of one-half the prescribed angle, describe an arc *N N*, intersecting the arc *M M*. With a 6-inch radius, this calculation for a 20-degree angle would be as follows: Sine 10 degrees = 0.17365. Then $6 \times 2 \times 0.17365 = 2.0838$ inch radius. A line then drawn through the point of intersection of these two arcs will be at an angle of exactly 20 degrees from *D D*. The sine of the angle may, of course, be obtained from a table of natural trigonometrical functions, which will usually be found in any milling-machine catalog or mechanic's handbook.

Another application of this method would be in the laying out of a number of holes equally spaced around the circumference of a circle, such as bolt holes in a flange. The method of procedure in this case would be as follows:

In Fig. 2 we will assume that the circle in which these holes are to be located is 4 inches diameter, and that the number of holes is 10. The angle between holes will then be $360 \div 10$. We will first describe the bolt circle with a pair of dividers. Then set the dividers with a radius equal to the radius of the bolt circle multiplied by twice the sine of one-half of the angle between holes. In this case the radius of the circle is 2 inches and twice the sine of ½ of $360 \div 10$ equals 0.61804. 2×0.61804 equals the desired radius, or 1.236 inches.

With this setting of the dividers, strike an arc intersecting the circumference of the circle at *P* and, stepping the dividers around to the point of intersection, strike another arc, continuing thus around the circumference until the holes are all located.

Dayton, Ohio. CHAS. CARLTON.

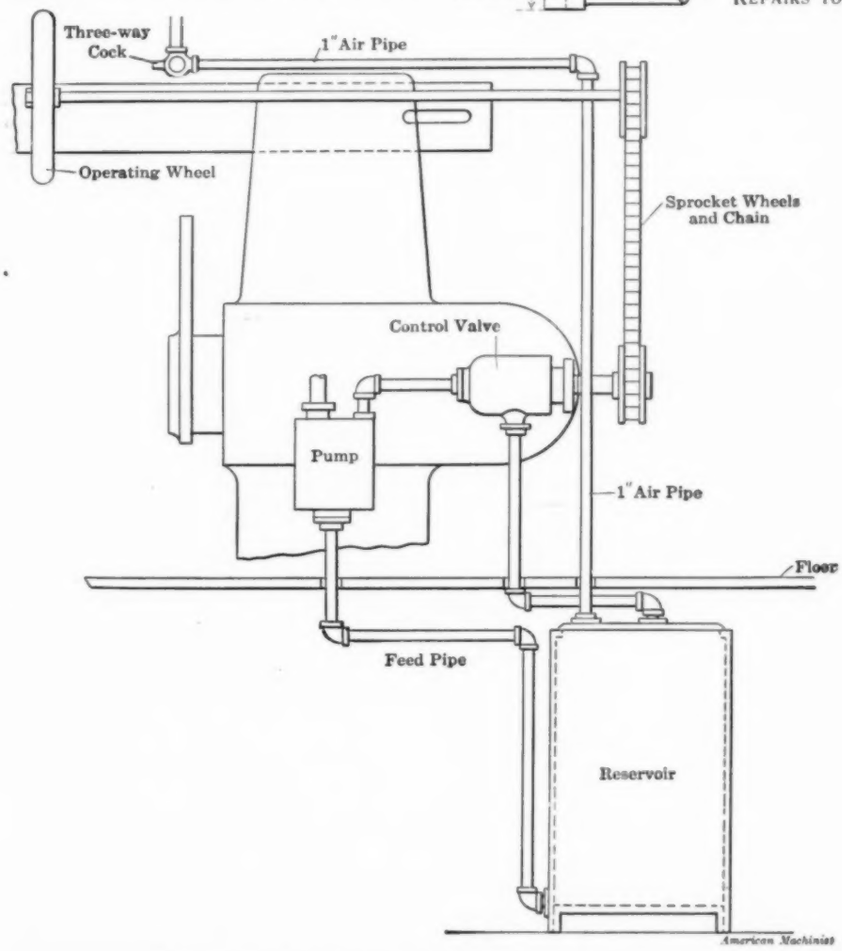
Compressed Air Applied to Hydraulic Wheel Press

There is nothing so useful around any shop as compressed air. In a certain railroad wheel shop the car-wheel work increased on the three wheel presses to such an extent that we were unable to handle it in 10 hours and I was ordered to investigate as to what improvements could be made.

I noticed that there was considerable time consumed in pumping the ram up to the work, although we had low- and high-pressure pumps on all of our presses. To increase the speed of the ram, I placed an old air reservoir under the floor and attached the air pipe as per sketch. This increased the output as much as 10 or 12 pairs per 10 hours.

There are no changes to make to the pump, as the water is simply pushed through the old intake connection. The air can remain while the pump is working, but it is best to release the air early, so that the ram will return promptly..

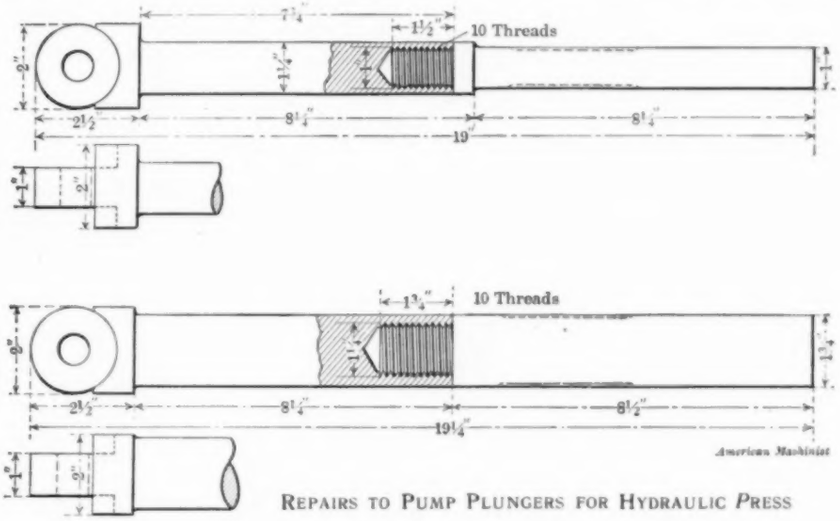
Elizabeth, N. J. W. A. ANTHONY.



COMPRESSED AIR APPLIED TO HYDRAULIC WHEEL PRESS

Hydraulic Press Repair

In looking over some of my papers I find a record of two pump plungers from a 150-ton hydraulic car-wheel press that



REPAIRS TO PUMP PLUNGERS FOR HYDRAULIC PRESS

I repaired in 1903. Thinking that it might be of interest to your many readers, I inclose a sketch of these two plungers that have stood the test for over six years.

The pump attached to this press is of the eccentric type, made by the Niles Tool works. The plungers are high- and low-pressure and they were both worn to such an extent, as shown by the dotted lines on sketch, that it was impossible to keep packing in the stuffing boxes.

To save making two new plungers complete; which would have meant considerable work, forging and machining; the worn ends were cut off and, in less time than it would have taken to forge the new plungers, the old ones were repaired as shown.

The old plungers were put in a lathe with a steady rest, cut off, drilled and tapped. A piece of machinery steel was then turned and threaded to fit.

In such work as this, the new end should be left about ⅛ inch larger than the finished size, for truing up in case there should be a little spring after the two parts have been screwed together.

This press has been in service every working day since it has been repaired and to this day one can scarcely see where the two parts are joined together.

A feature of this repair is that at any time the plungers become worn again it will cost but a trifle to repair them.

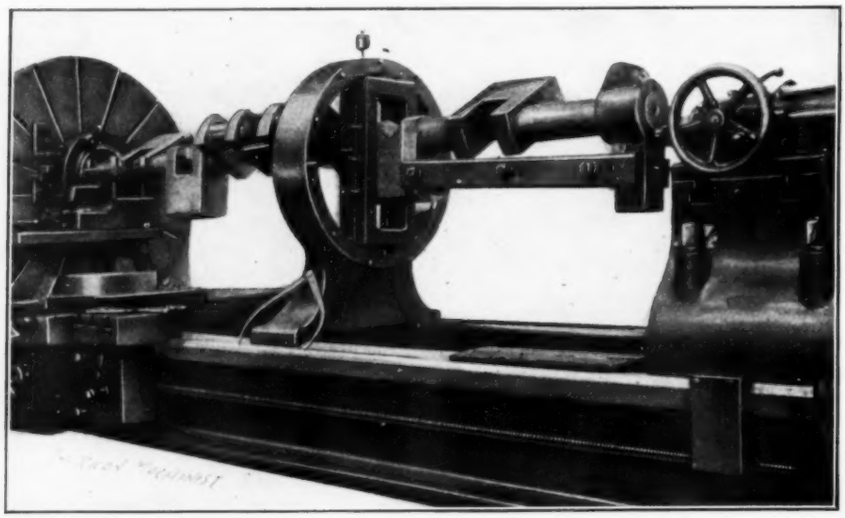
Stroudsburg, Penn. W. H. SNYDER.

Steady Rest for Crank Shafts

The White & Middleton Gas Engine Company, of Baltimore, Md., use a simple and ingenious steady rest on their lathe when turning crank shafts, as shown in the illustration. It consists of a solid cast-iron ring with feet cast to it that straddle the ways of the lathe and slide back and forth along the crank shaft. Inside this ring revolves another casting that has an oblong opening to fit over webs of the crank shaft. This has set screws in it that cramp the shaft tight.

As will be seen the steady rest can be brought up close to the tool carriage and hold the crank rigid while it is being turned on the shaft, the crank pins or the webs. For extra long shafts like the six-throw crank shaft shown in the lathe, straps are bolted on each side of the steady rest to further stiffen it. This makes a simple, easy and quick manner of holding the shaft solid at any given point, so that it can be machined perfectly accurate without springing out of shape.

New York, N. Y. E. F. LAKE.



STEADY REST FOR CRANK SHAFT TURNING

Electric Arc Welding

There has been a great amount of space taken up in different mechanical papers regarding electric-arc welding, and in all of them that I have read I have not found any that give arc welding its just dues or what it is capable of doing. I have been personally interested in arc welding for the past four years, and during that time have had the opportunity of coming in close contact with all classes of work, ranging from the smallest part of an automobile to locomotive frames and cylinders, steel, cast iron and brass castings. I have also been able to successfully weld new teeth in steel and cast-iron gear wheels that practically need no machining after being welded.

Different writers and mechanical engineers claim that cast iron cannot be electric-arc welded with any success, or if welded cannot be machined. I beg to differ with them, for there is not a day that I do not weld numerous cast-iron jobs and every one is machined after welding; the weld oftentimes being softer than the original casting.

In the last few years there has been brought to the front different methods of doing welding, but of all of them electricity is the cheapest and quickest, consequently it means a great deal to the manufacturer or the one who has something to be repaired.

In order to do electric-arc welding successfully it is absolutely necessary to have perfect control of your current, which vary according to the class of work you have to do. If the arc is too hot you will burn the metal, or if not hot enough the metal will not properly unite and you will have what is commonly known as a frozen weld. My experience has taught me that the proper equipment to use is a motor-generator set generating 125 volts direct current, with a hand regulator to enable one to adjust the generator at a required voltage, or in other words, to suit the work. In conjunction with this it is also necessary to have a wooden tank, of sufficient size, containing salt brine and six steel plates equally divided as to the space between them, a switchboard equipped with one main double-pole switch, five single-pole switches, circuit breaker, ammeter and voltmeter.

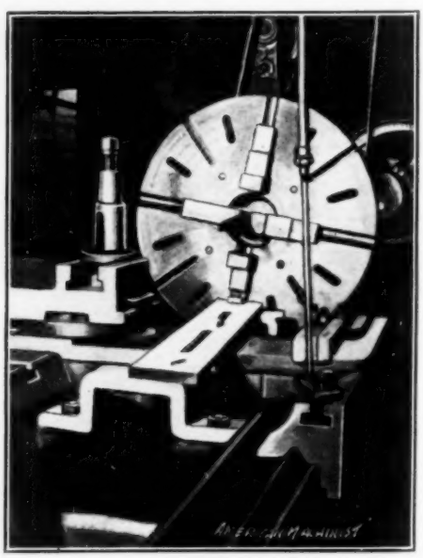
The two mains from the generator should be carried to the two bottom terminals of the main switch; the positive side going through the switch to the circuit breaker and from the breaker to the iron table, or wooden table with boiler-plate top, the cable being securely bolted to same. The negative side of the circuit is carried by means of a copper plate 2 inches wide and ½ inch thick. The single-pole switches are arranged in a straight row and all bolted to a copper busbar, the busbar being connected by the copper plate previously mentioned, which, of course, is the negative side.

You then run a cable from each of the five switches to five plates in the wooden tank, the sixth plate being reserved for the arc; by putting these switches in, in rotation you get the desired amperage or heat. In a great many steel foundries and large manufacturing plants they simply make a connection on their power or lighting circuit regardless of the voltage and just as long as they continue by this method they cannot expect good results from arc welding or further its advancement. J. D. PETERS.

Schenectady, N. Y.

An Improvised Taper Attachment

Having a string of well tools to make with tapers from 5 to 7½ degrees and no taper attachment, I devised the one shown in the halftone which produced a satisfactory job, was made of scrap iron and cost very little to make. The top plate is a piece of ¾x4-inch steel, 24 inches long, with a slot 1 inch wide in it for the screw which goes in the cross slide to work in. The end pieces, which bridge from side to side of the ways are made of 2x¾ inch steel. They are bolted fast to the bed and the top piece being set at the correct taper the cross-feed screw is disengaged and the taper screws, male or female, are readily cut, using the compound rest for feed.

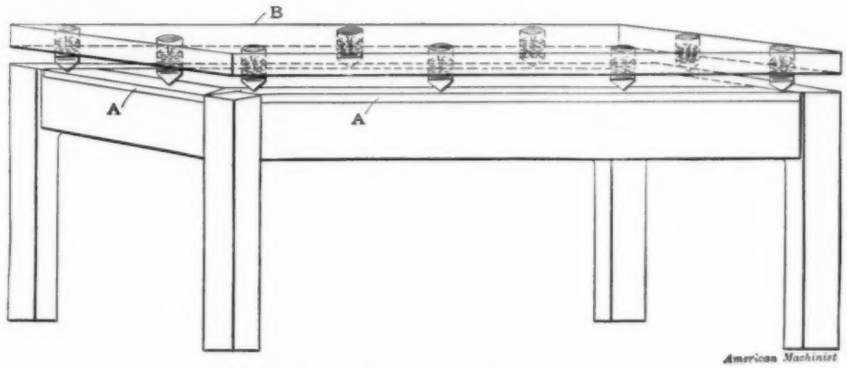


AN IMPROVISED TAPER ATTACHMENT

Seattle, Wash. G. C. SMITH.

Laying Off Table

The accompanying drawing shows the way in which a laying off table can be made. A small laying off table is something that is very handy and especially around a small shop. It is expensive to make a laying off table by building it up from the ground, but this table is inexpensive in comparison with those that are built on a foundation.



A CHEAP FORM OF LAYING OFF TABLE

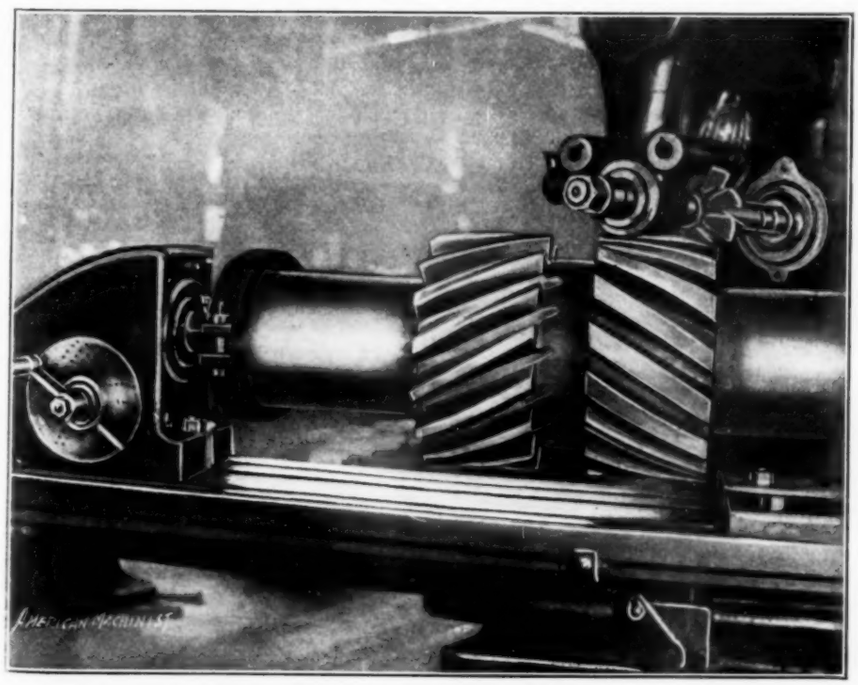
An ordinary table is made as shown; it is, of course, built to suit the cast-iron surface plate *B*. There is a machine-steel strip, shown at *A*, ¼ inch thick by 2 inches wide, placed around the top of the frame of table. The frame is cut down to allow the strip to come flush with the top. A number of ¾ holes are drilled and tapped around the edge of face plate as shown, the number determined by size and weight of surface plate. Set screws are placed in the holes, one end of the set screws have a 60-degree cone point. When face plate is placed on table, the set screws are run through and the cone points will seat themselves in the strip *A*. These screws are to level up the surface plate. When the table has been moved around on the floor and is not level the set screws are then adjusted to suit the floor and by so doing the face plate will become level.

H. D. CHAPMAN.

Washington, D. C.

An Unusual Job for a Milling Machine

The accompanying illustration shows an unusually heavy job for a No. 4 Brown & Sharpe milling machine. There were two gears of the same size cut in this manner. The length over all was 40 inches, outside diameter 13½ inches, shaft 9 inches diameter, 2 inches normal circular pitch, 70½ inches lead, angle of spiral 28 degrees 30 minutes, 16 teeth.



AN UNUSUAL JOB FOR THE MILLING MACHINE

It was necessary to block up the index head and to put an extension on table to carry tailstock. The gears were first blocked out with a high-speed cutter and then finished with a form cutter made of 0.30 carbon machine steel, case-hardened. This cutter did the work as well as one of tool steel, although not much was expected of it. Since that time, however, a great many tools have been successfully made of the same material.

As one of the gears neared completion, one of the change gears came out of mesh, the result was a groove equal to the diameter of the cutter across one face of the gear. Luckily, however, someone thought of the welding process and the gear was saved. After the cutting was complete the welded tooth could not be located and the trueness of the gear had not been affected in any way.

In conclusion I would strongly advise anyone desiring such gears to do without them rather than cut them on a milling machine.

Pittsburg, Penn. W. H. M.

The Little Motor Again

BY O. S. BICKFORD

I do not believe in trying to get the last word or provoke an argument, but the comment of our friend Henry Hess as to my little motor tale wherein he seems sure of a better plan than ours, leads me to give a few more facts in the case. At the time we bought the second motor we had for some time been using two lathes, two drill presses, a planer, a punch press and two milling machines, one of which called for a three-horsepower motor drive. All of these machines were being used every day, more than half of them simultaneously, and I can positively assure Mr. Hess that our little two-horse motor did not expend even one-third of its energy on tight belts or shafting out of alinement. I am firmly opposed to tight belts, and have within two months taken off a nearly new (patented) canvas belt which would not pull an 18-inch shaper to suit me, and on which the makers said I must not use belt dressing, refusing to even unroll a new and heavier one which was sent to replace it. We put on an old leather belt, a little dressing and are getting results. Of course, the name Hess suggests anti-friction bearings, and while I do believe in them, I feel bound to uphold my little two-horse motor. We are now using in all 22 machines, keeping 12 men busy operating them, and feel justified in using a three-horse motor to help the "little two."

The production of steel railroad ties and fasteners in Germany increased from 123,000 tons in 1888 and 356,000 tons in 1906 to 494,000 tons in 1907.

Discussion of the Previous Question

Letters from Our Readers Showing how many Men of many Minds Look upon Various Subjects Opened up in previous Numbers

Etching and Etching Fluids

On page 555 of the AMERICAN MACHINIST, Wm. S. Rowell asks for information regarding the etching of tools.

The action of the etching fluid on different steels is due, as Mr. Powell suggests, to the chemical nature of the metals, high-carbon and alloy steels being acted upon more slowly than low-carbon steels and wrought iron. This slow action on high-carbon steel and cast iron is also due to what might more properly be called mechanical agencies. The removal, or dissolving of the iron, leaves a protective coating of insoluble carbon which prevents further action of the acids; and in some cases, where the action of the acid is *quiet*, salts and compounds are formed which prevent fresh acid from coming in contact with the metal.

These difficulties may be overcome in several ways: The carbon may be brushed or scraped off, or the nature of the etching may be so changed that the chemical reaction is more violent, or accompanied by the rapid evolution of gas, which acts in a mechanical way, breaks up the film of carbon or salts and carries it away, allowing fresh acid to come in contact with the metal.

With cast iron where the amount of carbon is very great, it is often necessary to wash the spent acid and carbon off, and put on fresh acid, repeating the process as often as required.

Another frequent cause of trouble is the wax or protective coating used. Beeswax is all right, but should be put on *very thin*, for when the coating is heavy, the "point" or marking tool, forms deep grooves in it that prevent the free access of the acid to the metal. I prefer to tie the wax up in a piece of silk, then warm the piece to be etched and rub the pad over it, thus leaving a very thin and even coating of wax. If the piece is too large to be warmed the wax may be spread on with a hot spatula, or old hack-saw blade, heated good and hot, or, the wax may be dissolved in benzine or chloroform, and applied with a brush.

Mr. Powell can readily demonstrate to his own satisfaction that *pure* nitric acid does not act readily upon steel. Take a small quantity of pure acid in a glass and insert the end of a piece of drill-rod. The action is rapid for an *instant only*. If now the acid is diluted with an equal part of water, it will be seen that the steel is being gradually eaten up. The reason for this is, that the action of nitric acid on most metals is a double one. The metal being first changed to an oxide and then into a nitrate, and with certain metals as iron, silver, etc., additional hydrogen and oxygen are required to make these reactions possible, so we supply them by the addition of water (H_2O).

Again we may obtain more rapid and *even* results if a small amount of copper sulphate (blue vitriol) is added to the acid, about 1 dram to 2 ounces of acid; the reaction in this case being a triple one.

The proper proportion for nitric and muriatic acids is, nitric 1, muriatic 4, and is known as nitrohydrochloric acid. It will dissolve gold, platinum and a number of other metals that are not soluble in either acid alone, which is due to the fact that this combination of acids liberates chlorine, which in its *nascent* state is a solvent of these metals, and we obtain, chlorides of the metals.

Still another method is to apply sulphuric acid to the part to be etched, and then to sprinkle on this fine table salt. In this case the sulphuric acid decomposes the sodium chloride, liberating chlorine which in turn unites with the iron forming a chloride.

I have given here such methods as are practical in the machine shop, and have made no attempt to describe the methods used for the finer work, such as steel and copper etchings, and the placing of trademarks, etc., on the tools and cutlery.

Good etching fluids may also be used to loosen small broken taps and drills, and diamonds that have been brazed into steel holders may be readily removed without danger of breaking, by surrounding the stone with a small cup of wax and applying the acid, washing out the spent acid, and renewing as often as necessary.

Perhaps it will not be out of place to give a good coppering solution for I find that there are very few who know how to make a good solution, or how to use it so as to obtain the best results.

Take 4 ounces of distilled water (or rain water) and add all the copper sulphate it will dissolve, then add 10 drops of sulphuric acid. Test it by applying to a piece of steel with clean waste. If it doesn't "take hold" add 5 drops more of the acid, but don't make the mistake of getting in too much, for it will eat the steel and prevent good results.

To prepare the surface to be coppered, remove all grease and polish with fine emery cloth, then apply the solution with a piece of clean waste. If the coating of copper does not show up bright and clean or has a tendency to flake off, put on a few drops of the solution and with a piece of fine emery cloth scour the surface, which will become black and muddy. Put a small quantity of fresh solution on the swab and go over the work rapidly, and a beautiful burnished surface of copper will be obtained.

Don't use too much of the solution and have the work free from grease.

Indianapolis, Ind. H. M.

Heat Treatment of Steel

On page 324 I repeated a story told me by a man I *know* to be a good mechanic. It sounded *queer* to *me;* that's why I repeated it.

The man who told me the story had verified it as far as he could.

Mr. Sirius on page 603 says, "Probably neither Mr. Bain nor his friend has ever heard of the spark test, etc." I don't know about my friend's knowledge on this point but I suspect he reads the AMERICAN MACHINIST, I know he is not asleep when I call on him and I imagine any one year's apprentice would know of the spark test. My own experience with the spark test dates back 30 years and the man who called my attention to it told me he had used it ever since "Mushet" came out. Mr. Sirius says, "the proportion of dead sparks shows its quality or temper." Will he please tell us how to distinguish between a dead spark and one which is merely moribund? If by *dead* sparks he means *the particles which do not glow*, then I would like to know, not how he counts the proportion, but how he sees them at all.

New York City. J. H. BAIN.

Concrete Floors

I find workmen object to concrete floors for two reasons, and my observations on this subject do not quite agree with the article on page 279.

I know of a shop where the floor is made of concrete and where the men complain very much of the cold and it is significant that rheumatics and varicose veins are rather common complaints, though this shop is situated in a district where these troubles cannot be attributed to dampness. While I am prepared to admit, that if the concrete floor was properly heated, as described on page 241, this trouble might be greatly, if not altogether removed, yet there is another

point to be considered; namely, the elasticity of the floor. As regards this, my experience has been "that it is too hard," and that even an ordinary wood floor can be improved. The following simple device was adopted in a shop, and I know greatly added to the comfort of the operators. It was a board about 30 inches long by about 15 inches broad; on the under side of this and at each end was a cross-bar about 1 inch thick. This formed a stool on which the man stood, and offered a certain amount of elasticity, which was found to be very helpful to him as the weight of his body was thrown on the right and left leg alternately, due to the oscillations of his body while working his machine.

That which adds comfort to the operator almost necessarily increases the output.

Glasgow, Scotland. CRESTON.

Classification of Bolts and Nuts

At page 46, R. W. Rogers shows methods of designating the sizes of bolts and nuts. From the last sentence in the article I infer that these methods are in actual operation.

If I understand correctly there are two methods shown. In the first method a ½x2-inch bolt would be 416. A ⅝x2-inch one would be 516 and a ¾x2-inch one would be 616. So, also ½x2½-, ½x3-, ¾x4-inch, etc., would be 420, 424, 432, etc. I am not sure how the 5/16-inch bolts are to be taken care of, nor the ones 36 and 48 inches long, which we use in considerable quantities. Diameters in even eighths and lengths of not more than 12⅜ inches in even eighths could be worked into such a system. That would take in most of the ordinary supply.

The bolts known as 416, 516 and 616 by this system would be known in the second system as 401, 501¼ and 601½, and the ones known as 420, 424 and 432 would become 401¼, 401½ and 402.

To further illustrate these methods as I understand them I have made a table of a few sizes.

Common Way.	First Method.	Second Method.
½x2	416	401
2¼	418	401¼
2½	420	401½
2¾	422	401¾
3	424	402
⅝x2	516	501¼
2¼	518	501⅜
2½	520	501½
2¾	522	501⅝
3	524	501¾
¾x2	616	601½
2¼	618	601⅝
2½	620	601¾
2¾	622	602⅛
3	624	602¼
1x7	856	807
1⅛x 4	1432	1407
1⅛x12	1196	1116¼
1⅛x11	1388	1317⅛
1⅛x11¼	1390	1318.28125

My understanding of our present system of numbers is that it is a system capable of general application reduced to its simplest form. Because of this, various other systems that are more convenient for some uses, but which are not fit for all uses have been devised. The excuse for their being is that in some places they are better than our general system, generally because they save labor.

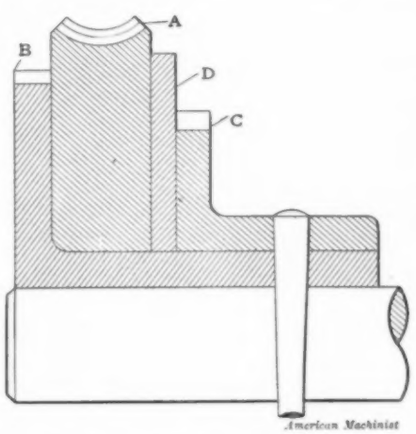
It is fair to assume that Mr. Rogers has found his systems of designating bolts better than the usual one under some conditions, but I cannot imagine what the conditions are. Unless they have some very decided advantages to offset the disadvantages which the table shows they would be expensive things in the ordinary stock room.

There is one thing certain, and that is that their use would reveal any lack of familiarity with the multiplication table. It would be interesting to know, in time, labor or money saved, the advantages of such systems, and also to know the range of their application.

Oil City, Penn. W. O. PLATT.

Time Saver for Milling Machine Turret

S. E. Pagement, at page 273, criticizes my conception of the principles governing the working of a device for saving time between operations on a milling machine. In my original article, which appeared at page 958, Vol. 32, Part 2, the last sentence was to the effect that the speeding up is due to the difference in the respective diameters of the ratchet wheels. It is obvious that such can be the case only when the respective pitches of the wheels are the same and it is merely a matter of ringing the changes on the diameters and pitches to get any specific ratio required.



TIME SAVER FOR MILLING MACHINE

In the criticism referred to, Mr. Pagement raised an interesting point in connection with obtaining a dwell between the slow and fast speeds. The period of dwell it is possible to provide must necessarily be very small compared with the revolving period if at the same time we are to get any appreciable difference between the two speeds. That is to say, to get the dwell required, we must have a long tooth on ratchet wheel *B* and consequently to obtain the difference in relative speeds, wheel *B* would have to be very much larger in diameter than wheel *C*.

It has been mentioned to me that it may not be immediately evident how the connection is made between the ratchet wheels to still leave a free bearing for the worm wheel and pawl plate. The sketch should make this clear if taken in conjunction with the previous sketch on page 958.

J. H. JOHNSON.

Glasgow, Scotland.

Boring Crank Pin Holes in Crank Disks

At page 126, H. Maplethorpe, in an article on the above subject, appears to have run into a trouble that I suppose every tool room experiences, and this when the cause is known and precautions taken. The editor in his foot note, says: "Boring in the lathe, if carefully done on a true lathe, ought to produce as good work as any other method." Yes, this hits it; *if carefully done on a true lathe.*

In boring jigs on the lathe when the jig is fairly heavy and the distance between holes such that the work requires balancing, this lack of parallelism is most troublesome, and unless very great care is taken in the balancing, poor results are met with, and even when the care taken is exceptional, if long test bars are inserted in two holes the indicator will reveal a small error at the extreme ends. This is capable of easy proof. Take a heavy piece of material that has been machined on the back, and which is about as long as the lathe will swing, mount on the face plate and bore a standard size hole in one end, turn end for end and bore a similar hole, then insert two long test bars in the holes and set up the surface plate with both test bars in the same vertical plane and one bar parallel to the table; now try the other bar, and the indicator will show the error. Another way to observe the effect of lack of balance is the following: Bore a hole in a piece of work that is slightly out of balance, and when the hole is smooth, change the speed of the lathe. If now the tool is brought to the hole it will be shown to be out of true. This is so well known in tool rooms that when a man sets a jig from a button, he does it at the same speed that he intends to use for boring.

Two potent causes of trouble, other than balancing, in this sort of work, are: A weak faceplate, and undue clamping

of the work, and I think, from the shape of his job, that Mr. Maplethorpe's trouble is a combination of all three.

Eliminate then the chances of error from these three causes, and the bores will be parallel with each other, or the error so small as to be negligible and, as the editor suggests, the hydraulic press will do the rest.

WALTER G. GROOCOCK.

Woolwich, England.

Drawing Board Templets for Laying Out Details

At page 365 is shown T. J. S. Kishpaugh's drawing board templet for laying out details. Why not carry the idea farther, and instead of punching out the centers only, cut out the piece to be laid out? In the case shown on page 365, cut out the outline of the ball handle and thumb nut. To make the drawing, lay the templet on the drawing and with a sharp-pointed pencil follow along the outline and the drawing is finished in a few moments, without any instruments other than a pencil.

Elyria, Ohio. A. B. HOWK.

Self Registered Press Tools

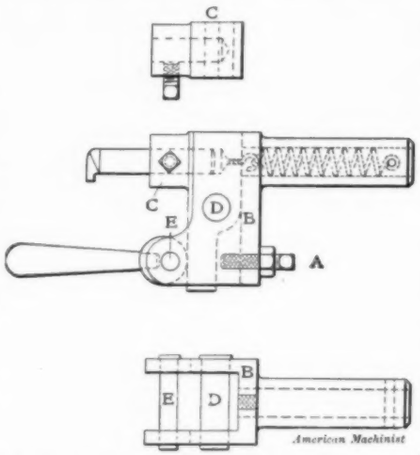
In the article by O. D. Clerkenwell, at page 131, in which he refers to H. Harris's article at page 787, Vol. 32, Part 2, on Self Registered Press Tools, he states that every French press toolmaker knows that the proper way is to lay out the guide plate first. Evidently, Mr. Clerkenwell and Mr. Harris are talking about different things, the former about an ordinary class of punches and dies, and Mr. Harris about first-class press tools for the rapid duplication of accurate parts. Every toolmaker has had the experience of seeing his dies warp in the hardening with the consequent trouble entailed in grinding and oilstoning out afterward, no matter how carefully they are hardened, and to make the guide plate first would be bad practice. I have never yet met a toolmaker who made his tools Mr. Clerkenwell's way. It surely must have occurred to him how much easier it is to do it the other way, that is, mark off, drill and machine the punches and guide plate to a hardened die, then to make the die to a soft guide plate and take the chance of the die going in the hardening. How about the steady pins, let alone the punches in such a case?

I most certainly agree with Mr. Clerkenwell in the matter of a templet, but by all means, make your die first and harden; then your punches, and set them in the punch holder; then you can let the punches through the guide plate and into the die. You have them all in line then, and what is easier than to drill the steady-pin holes and screw holes right through the holes already in the hardened die? You cannot help getting them right then.

London, Eng. A. S. POWELL.

A Recessing Tool for the Turret Lathe

At page 364 is shown a recessing tool for the turret lathe. The cam-lever feed



RECESSING TOOL FOR THE TURRET LATHE

is very desirable on account of being so close to the tool, as it gives the operator a chance to feel the cut, as we might say. The arm which carries the cam lever I should think might be in the way of the operator.

The sketch herewith shows a design which is practically the same, with the exception that the cam lever is attached to the body of the tool. This is an advantage as there is only one part to look after, and it is also cheaper to make. The set screw *A* acts as an adjustable stop.

Waterbury, Conn. C. SCHWAEBLE.

White Lead and Oil as Lubricant

A boon to anyone who turns crank shafts or other work which is apt to heat at the centers is the use of white lead mixed with the oil used on the centers. Make the mixture about the thickness of cream.

Ontario, Can. A. D. SCOTT.

Removing the Points of Broken Drills

The scheme described at page 102, by F. W. Cedarleaf, is all right, but it is not necessary to spoil a nice twist drill, as a piece of 3/16 or ¼ Stub rod flattened on one end with the notch filed in, and with the necessary cutting clearance on the point, will do the job.

Chicago, Ill. M. JACKER.

Helping the Foreman Along

Some time ago when foreman in a shop on the Clyde, one of my duties was, in case of accident, to fill up a form giving full particulars as to the name, address, age, cause of accident, etc., before the injured party left the works, "dead or alive," this being required in connection with the workman's compensation act.

One day after starting a boy to fit some bolts in a large bedplate in the erecting shop, I was somewhat surprised, a short time after, to see him enter my office with one hand swathed in bandages and in a pained voice ask for a pass-out as he could not work. I commenced right away with my accident form, and it was quite a simple matter until the space for "Cause of Accident" was reached.

"How did it happen, I asked?"

"Och! I jist mis't ma lick," he replied. And "missed his lick" was duly entered upon the form, and proved quite satisfactory to his majesty's inspectors, and has also made the filling up of these forms a much simpler matter in future.

Another instance where a simple answer was of great assistance occurred in an Irish shop. One of the "bhoys" had roughed out some rods not wisely, but too well, and the man at the grinder was in the right frame of mind to give a "putting-on stone" a fair trial. As this had happened before with this particular "bhoy" a severe reprimand was "put in hand" at once, the culprit being allowed some time to get ready for it. When in due course he was asked how to account for it, he answered: "Shure, surr, it will not happen again, I've filed a wee bit off my calipers."

This simple answer not only made it much easier for the "bhoy" himself, but also made it much easier for the foreman to explain to "the powers that be" and saved a "sulphuric smell" from permeating the shop.

Belfast, Ireland. TERRY.

According to the *Electrical World*, there has recently been placed in service at Gothenburg, Sweden, an electric welding equipment installed in an old barge that can be towed alongside any steamer needing repairs. A De Laval turbogenerator furnishes direct current. One end of the barge has a workshop, with anvil and vise benches and a full equipment for small repairs. The anvil block is a steel slab 10.5 inches wide by 2.5 inches deep, and the negative from the generator is clamped to it, the positive being the holder, with insulated handle, held in the operator's left hand. The current passes through the jaws holding the specially prepared rod, 3/16 inch in diameter, used for welding. The pieces to be welded with chamfered edges, are secured in position on the anvil block ready for the electric arc.

Power Required to Remove Metal*

By Charles Robbins

The power required to remove metal depends upon the nature of the cutting tool and the amount of metal removed per minute. Cutting tools may be divided into three general classes: (*a*) lathe-tool type; (*b*) drills; (*c*) milling cutters.

Lathe-tool Type

The lathe tool is used on lathes, boring mills, planers, shapers and slotters. Tests show that the power required by a tool of this kind when removing metal depends upon the cutting angle of the tool and the number of cubic inches of metal removed per minute. From observation and data obtained by means of the graphic recording meter, and the use of tools having a cutting angle of about 75 to 80 degrees, the curve shown in Fig. 1 was obtained. The results were independent of the cutting speed, feed and depth of cut, and show that a definite relation exists between the horsepower required to remove metal and the number of cubic inches removed per minute. The cubic inches of metal removed per minute were found to be as follows:

(*a*) area of cut (square inches) × cutting speed (feet per minute) × 12

(*b*) area of cut (square inches) = depth of cut (inches) × feed (inches per revolution.)

The horsepower required to remove metal with the tools ordinarily employed can be expressed by:

horsepower = a constant × cubic inches removed per minute.

The constant varies with the kind of metal removed.

In order to estimate the amount of power required to remove a given amount of metal per minute the graphic method shown in chart 1 has been designed. This diagram is a multiplication table; those familiar with analytical geometry will recognize the equilateral hyperbola whose equation, referred to its asymptotes, is xy = constant.

To determine the cutting speed the usual procedure is as follows:

$$\text{Cutting speed (ft. per min.)} = \frac{\pi \times \text{diameter} \times \text{r.p.m.}}{12} = \text{constant} \times \text{diameter} \times \text{r.p.m.}$$

In the diagram each hyperbola corresponds to a given cutting speed. The coordinates of all diameters and spindle speeds producing the same speed intersect on the same hyperbola. The cutting speed corresponding to any diameter, rotation at any number of revolutions per minute, is found indicated on the hyperbola passing through the intersection of the coördinates corresponding to the given values of diameter and revolutions per minute.

In a similar manner an area corresponding to any depth of cut in inches and feed in inches is obtained, and also the cubic inches of metal removed per minute can be determined from the area of cut and the cutting speed. The directions for using the diagram are given in connection with it.

With the cutting tools ordinarily employed the following values have been found by tests to exist for the horsepower required to remove 1 cubic inch of the following metals, per minute:

Brass and similar alloys	0.2 to 0.3
Cast iron	0.3 to 0.5
Mild steel (0.30%-0.40% carbon)	0.6
Wrought iron	0.6
Hard Steel (0.50% carbon)	1.00 to 1.25
Very hard tire steel	1.50

It must be remembered that these constants represent general average conditions; considerable variation may occur where special cutting tools are used and special grades of metal are encountered.

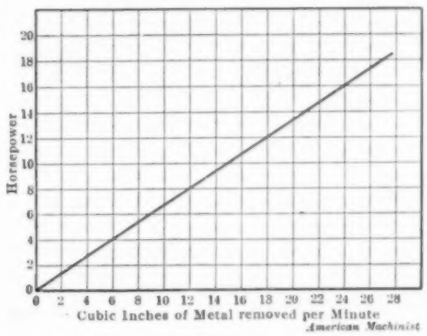


Fig. 1. Relation between Horsepower and Cubic Inches Metal Removed; Mild Steel, 0.40 Per Cent. Carbon

Lathes

The following examples will explain the application of chart 1 to lathe work: Example: Diameter of work = 5.5 inches; spindle speed = 45 revolutions per minute; depth of cut = 0.45 inch; feed per revolution = 0.06 inch.

Find the intersection of the horizontal line through 5.5 inches diameter of work, and the vertical line through 45 revolutions per minute spindle speed. The curves passing nearest this intersection correspond to a cutting speed of 63 and 68 feet per minute, indicating by interpolation a cutting speed in this case of 65 feet per minute. The area of cut, with depth of cut 0.45 inch and feed 0.06 inch is 0.027 square inch. The cubic inches of metal removed per minute, corresponding to an area of cut 0.027 square inch and a cutting speed of 65 feet per minute, is determined by finding the intersection of the horizontal line passing through 0.027 square inch area of cut and 65 feet per minute. This intersection is between the curves corresponding to 19.2 and 21.6 cubic inches, showing that about 20 cubic inches of metal are removed per minute. If the metal removed is wrought iron, the horsepower required is 0.6 × 20= 12 horsepower. If 0.50 per cent. carbon steel is turned, 1 × 20 = 20 horsepower, is required. Brass would require 0.25 × 20 = 5 horsepower.

Boring Mill

Example: Diameter of work = 45 inches; speed of table = 4.5 revolutions per minute; depth of cut = 0.25 inch; feed = 0.10 inch per revolution.

The diameter of work goes only to 10 inches in the vertical column of the diagram. These may be multiplied by 10, and if used with the spindle speeds as they stand, the results in the oblique column of cutting speeds must be multiplied by 10. In case of large diameters the spindle or table speeds are usually low. The simplest way to use the diagram in these cases is to interchange diameter of work and spindle speed, i.e., assume that the diameter of the work is 10, 20, 30, etc., in the horizontal column, and the table speed under 1, 2, 3, etc., in the vertical column. In the problem under consideration the cutting speed is as follows:

The intersection of the horizontal line through 4.5 and the vertical line through 45 correspond to a cutting speed of 52 feet per minute. The area of cut is 0.025 square inch. The intersection of the horizontal line through 0.025 square inch area of cut, and the vertical line through 52 feet per minute cutting speed lies between curves representing 14.4 and 16.8 cubic inches, indicating that 15 cubic inches are removed per minute. If cast iron of a soft quality is removed the power required for cutting will be 15 × 0.3 = 4.5 horsepower. If the cast iron is of hard quality, 0.5 × 15 = 7.5 horsepower, will be required.

Shaper or Planer

Example: Depth of cut = 0.75 inch; feed per stroke = 1/16 inch; cutting speed = 45 feet per minute (from characteristic of planer or shaper).

Area of cut 0.75 × $\frac{1}{16}$ = 0.046 square inch.

The cubic inches of metal removed per minute, corresponding to an area of cut of 0.046 square inch, and a cutting speed of 45 feet per minute, is 24. The power required for cutting in the machine a hard grade of cast iron will under these conditions be 24 × 0.5 = 12 horsepower.

In a planer the power required for

*From *Journal* of American Society of Mechanical Engineers.

reversing is usually considerably more than that required to cut metal, depending upon the design of the reversing mechanism, the flywheel effect and the speed characteristic of the motor. In a shaper the power required to reverse is not very great, and is usually less than the power required for cutting.

SLOTTER

In most cases the cutting tool is fed inwardly on this type of machine; the following example shows how the diagram is used to determine the rate of removing metal. With other methods of feeding the tool the diagram is used in the same way as in the case of a planer or a shaper. Example: Width of tool and cut = 0.5 inch; feed per stroke = 0.06 inch; cutting speed = 35 feet per minute; area of cut 0.5 × 0.06 = 0.03 square inch.

The cubic inches of metal removed per minute from the intersection of the horizontal and vertical line through 0.03 square inch and 35 feet per minute are 13. In the case of mild steel the horsepower required would be 13 × 0.6 = 7.8 horsepower.

[Charts for drills and milling cutters in a form similar to the one printed herewith, will be printed in succeeding issues. —ED.]

New Geared Head Turret Lathe

Special Correspondence

We show herewith the new geared head turret lathe built by the Whitcomb-Blaisdell Company, Worcester, Mass. The geared head is very similar to that used in their engine lathes and has been found particularly useful on turret-lathe work, having the advantage of being able to change the speed of the work instantly, is quite a time saver in work which requires both broad facing and small drilling.

Fig. 1 shows a gear blank which is being bored and faced by the tool equipment shown. The first facing tools have a serrated edge for breaking the chip and all are guided from the center hole.

Fig. 2 shows the gear blank being supported either by an expanding arbor or driven by a key. The arbor extends out beyond the work and forms a pilot or guide which enters the turning and facing tool body. This is a reversal of the usual procedure in the pilot in the tool itself which would, of course, be out of the question in this case. It is a very substantial tool and has been used for some time on their own work.

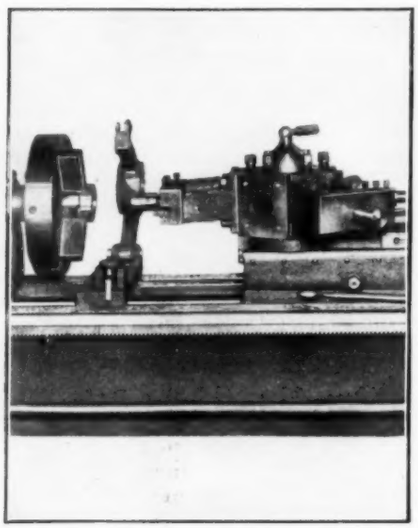


FIG. 1. BORING TH GEAR BLANK

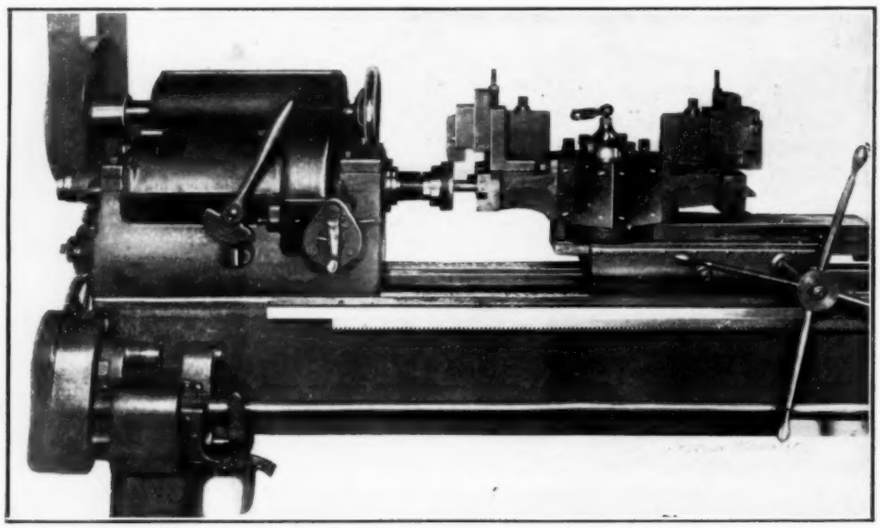


FIG. 2. FINISHING THE BLANK ON NEW GEARED HEAD LATHE

The National Metal Trades Association Convention

The twelfth annual meeting of the National Metal Trades Association was held at Hotel Astor, New York on April 13 and 14 and was notable for the helpful character of the papers presented and discussed. These included, Old Age Pensions, Compensation of Workmen, the Premium System, Employers Liability Insurance, Shop Management, The Cincinnati Continuation School, The Coöperative System and Insurance Against Unemployment.

A noticeable feature was the general feeling that this association had outgrown its original purpose, and had become a potent factor in all the forward movements which are making for the general good of the industry as a whole, which must include both employee and employer.

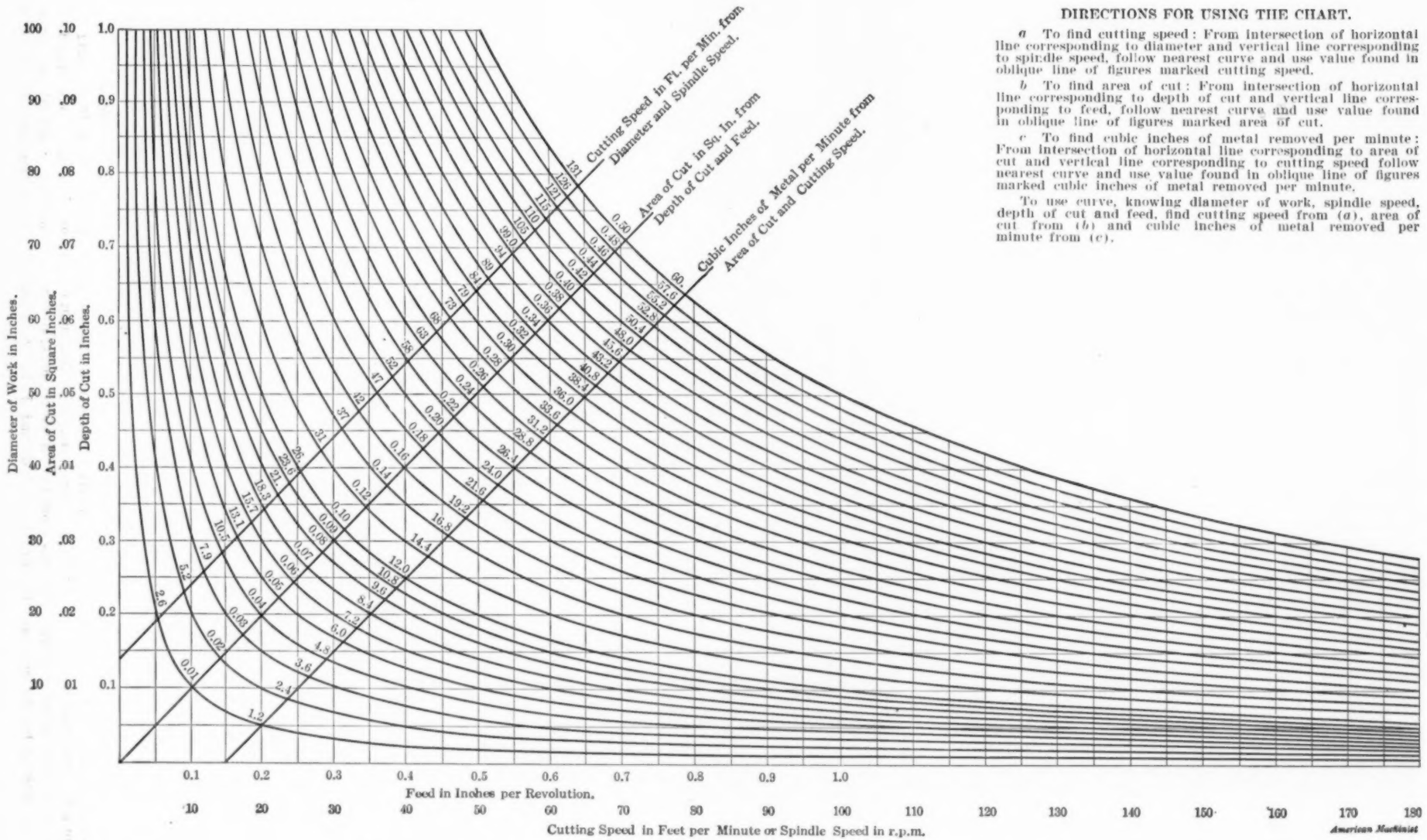
The officers for the ensuing year are: J. H. Schwacke, president, F. C. Coldwell and Paul B. Kendig, vice-presidents and Howard P. Eells treasurer.

The report of the commission showed a net increase in membership of 20 firms, making a total of 738 now represented. The spirit of helpfulness, not only to each other, but to the men employed by the members was distinctly manifest. There were several interesting papers on the Cincinnati Continuation Schools from two of which, presented by Dr. Frank B. Dyer and J. H. Renshaw, respectively, the following extracts are made.

GENERAL NEED OF CONTINUATION SCHOOLS

There is a serious gap in our country between the laws governing compulsory education and those regulating child labor. For example, in Ohio, children may quit school at 14, but the conditions upon which they may enter any trade are so onerous that they are practically excluded from trades until they are 16. If it would be a hardship to prevent them from going to work at 14 or 15, at least they should be required to continue in school part time and suf-

(*Continued on page* 756)


Diameter of Work in Inches.
Area of Cut in Square Inches.
Depth of Cut in Inches.
Cutting Speed in Ft. per Min. from Diameter and Spindle Speed.
Area of Cut in Sq. In. from Depth of Cut and Feed.
Cubic Inches of Metal per Minute from Area of Cut and Cutting Speed.
Feed in Inches per Revolution.
Cutting Speed in Feet per Minute or Spindle Speed in r.p.m.
American Machinist

DIRECTIONS FOR USING THE CHART.

a To find cutting speed: From intersection of horizontal line corresponding to diameter and vertical line corresponding to spindle speed, follow nearest curve and use value found in oblique line of figures marked cutting speed.

b To find area of cut: From intersection of horizontal line corresponding to depth of cut and vertical line corresponding to feed, follow nearest curve and use value found in oblique line of figures marked area of cut.

c To find cubic inches of metal removed per minute: From intersection of horizontal line corresponding to area of cut and vertical line corresponding to cutting speed follow nearest curve and use value found in oblique line of figures marked cubic inches of metal removed per minute.

To use curve, knowing diameter of work, spindle speed, depth of cut and feed, find cutting speed from (*a*), area of cut from (*b*) and cubic inches of metal removed per minute from (*c*).

MACHINE-TOOL CALCULATION FOR LATHES, PLANERS, SHAPERS, SLOTTERS AND BORING MILLS

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Contents

PAGE

Some Work Performed on Huge 60-foot Boring Mill 717
Making Lathe Lead Screws 719
High Speed Milling and Some Other Things 720
Another Use for Steel Balls 721
Straightening Motor Belts 722
A Successful Apprenticeship System in a Large Plant 723
Gear Hardening Practice at the Light Manufacturing and Foundry Company 725
Card Systems for Drawing Room and Shop Practice 726
A Gear Cutter Tester 727
Notes on the Design and Efficiency of Impulse Pumps 728
Emergency Welding Apparatus 730
Operation of the Federal Liability Law 731
Machining a Clutch Gear Having a Square Hole 732
Economical Features of Electric Motor Application 733
Two Special Riveting Devices 737
The Inventor as a Business Man 738
Principles of Thread Rolling and the Setting of Dies 739
Milling Speeds and Feeds—Settling Accident Claims 741
Letters from Practical Men:
A Novel Rack Drive....Laying Out Angles without a Protractor....Compressed Air Applied to Hydraulic Wheel Press....Hydraulic Press Repair....Steady Rest for Crank Shafts....Electric Arc Welding....An Improvised Taper Attachment....Laying Off Table....An Unusual Job for a Milling Machine 742-745
Discussion of the Previous Question:
Etching and Etching Fluids....Heat Treatment of Steel....Concrete Floors....Classification of Bolts and Nuts....Time Saver for Milling Machine Turret....Boring Crank Pin Holes in Crank Disks....Drawing Board Templets for Laying Out Details....Self Registered Press Tools....A Recessing Tool for the Turret Lathe....White Lead and Oil as Lubricant....Removing the Points of Broken Drills....Helping the Foreman Along 746-748
Power Required to Remove Metal 749
Danger in Over-expansion 751
Industrial Education and Welfare Work 751
Uncle Sam's Gear Data 752
New Tools and Machine Shop Appliances 753

American Machinist

Editorial

The Danger in Over-expansion

When business is booming and machine-tool builders are months behind in deliveries, it is neither pleasant nor popular to even intimate that it may be wise to remember the past when planning for the future. But history has a disagreeable way of repeating itself from time to time and it may be well to take account of stock before going ahead with too many new buildings.

One of the important factors in the machine business today is the building of automobiles, and even assuming that there is a legitimate field for all that will be built this year, is it not well to look ahead and think of next year and the next?

It is very natural that, as long as orders come in faster than they can be filled, we think of adding to our facilities and securing all of the trade possible. But the automobile is a comparatively new thing, as was the sewing machine and the bicycle in their day. They are both just as useful and as necessary as the automobile and they are being used in great quantities, but their business history is strewn with many a sad story of over expansion and financial wreckage.

It is fairly safe to assume that the rate of output of automobiles this year will very soon supply the regular demand in this country. If not this year, then next year or the year after. And it is certainly better to let a comparatively few go unautomobiled for a year or two than to court the dangers that lie in the path of over expansion.

If the factories are enlarged to meet the seeming present demand, many are apt to find a factory on their hands that will not be all needed in a few years. The manufacture of automobiles will be centralized the same as the sewing machine, necessitating only a very few large shops and leaving much money tied up in abandoned or partially worked plants.

This may react directly on the machine-tool builder and machine shops which are enlarged to meet the present demand, may easily become burdensome when part of that demand ceases. Following the bicycle line it is not unreasonable to expect to see this accentuated by the throwing of good machine tools on the market through the closing of some automobile shops, due to the centralizing that is already on the way.

We believe this very undesirable state of affairs can be avoided if the automobile manufacturers will follow their better judgment instead of being led away by the desire to build as many thousand cars as possible this year or next. If the bankers will adopt the policy advocated by one of their number recently, of advancing all the money that can be legitimately required to run the present plants to build cars, but to steadily refuse to finance further extensions of factories, the danger of over expansion may be avoided.

The same line of argument holds true with builders of machine tools who are thinking of enlarging their plants to meet the present demands of the automobile builders. It is much better to let your competitor sell a machine once in a while than to have part of your factory idle for long periods, with its overhead charges going on all the time. That is the heavy burden we must sometimes carry for over expansion in times of piping prosperity.

Industrial Education and Welfare Work

We are so apt to use words indiscriminately that they often cause confusion and give us a wrong impression. This is true in some quarters where industrial education is being classed with the so called welfare work, as in the case of the Santa Fe Railway System. While it is undoubtedly true that the training of apprentices adds to the welfare of the industry, it is so distinct from sanitary shop conditions and rest rooms, that it should be considered in an entirely different light.

Industrial education in itself presents so many problems that are far from final solution, that we shall do far better to consider it as a separate institution. The question of what to teach and how to teach it is an ever present problem that is occupying the minds of those who fully appreciate the need of well trained mechanics.

Welfare work, in spite of the abuse of the term, will continue to be a factor in all large industries. While usually considered as a system of providing comforts and refinements that are unusual in the industries, these alone do not spell success in securing the peace and har-

mony that insures good results to all concerned.

The small shop, with few men and no facilities for reading rooms or shower baths, may have more of the true welfare spirit there than a finely equipped plant where the human element is entirely lacking. The larger the shop, the harder it is to maintain the personal relations that mean so much to all men who are built of the right stuff and that are the real basis of true welfare work.

We sometimes try to make ourselves believe that the personal element cuts no figure in business life, but the fact remains that where all departments are in harmony, the results are always better. Anything that will further this is the best kind of welfare work, but it is not necessarily connected with industrial education in any way.

Uncle Sam's Gear Data

The way in which valuable engineering data can be mutilated in translation, and in fact, made worthless, is well illustrated by a few pages from a recent bulletin of the Department of Commerce and Labor. This bulletin deals with foreign machine-tool trade, and some three and one-half pages are devoted to information in regard to the designing of gears, as practised by a prominent European firm of gear manufacturers.

The original data were undoubtedly of value, but from the form in which they appear in the bulletin, we are led to believe that they were translated by someone entirely unfamiliar with gears.

To illustrate the character of the information: Such expressions as conical, helicoidal, endless, cylindrical gears with wedges, and green leather are used for the common expressions—bevel, helical, worm, herringbone and rawhide. In one place the angle of pressure is given as "75½ degrees on the line of the diameter." In another paragraph we have this remarkable sentence: "The module, or pas diamétral, is the quotient of the circumference by π". In discussing several gear formulas we find "primitive diameter" used for pitch diameter, "corresponding wheel" for engaging gear, "central angle" for center angle, "oblique or apparent pitch distance" for circular pitch, "straight-geared wheel" for spur gear, and "diameter of groove" for throat diameter of a worm wheel. Certain explanatory examples are given and an answer worked out for one of these is expressed thus: "245 millimeter 3," which is apparently intended for 240.36 millimeters. Another answer is expressed as "130 millimeter 73." Solving the equation gives as the result, 130.8 millimeters.

Further quotations are unnecessary.

We do not expect that a government department will be an expert on gear design, but we do expect reasonable technical accuracy in government publications, not such a kindergarten treatment as this is. At the same time there is very little excuse, anyway, for publishing such data in a report on machine-tool trade.

NEW PUBLICATIONS

THE LAW AND COMMERCIAL USAGE OF PATENTS, DESIGNS AND TRADE MARKS. By Kenneth R. Swan, of the Inner Temple, Barrister-at-Law. 386 pages, 5½x8¼ in. D. Van Nostrand Company, New York. Price $2 net.

Although the book in hand was written by a lawyer, from a lawyer's discerning point of view, it is not intended to be a legal treatise solely for the use of the profession, but is well adapted to the general reader. The body of the work is unincumbered with page citations to cases and it is written in a clear, readable, interesting style, necessarily rather summary considering the many phases of the subject which have to be covered. It is concerned directly and chiefly with English law and practice, taking account of the Patents and Designs act of 1907, and the Trade Marks act of 1905. Starting with historical principles, the author discusses the essentials of a patentable invention, passing on to explain how a patent is applied for and obtained, what the right secured amounts to, how it is amended, infringed, negotiated by sale or license, limited, prolonged, etc. Attention is then turned to foreign patents and a summary is given of the laws in America, Germany and France. Particularly useful for reference are tables of the various fees required for taking out a patent in Great Britain and of the costs in many other countries. The chapter which may be regarded most pertinent at the present time is the one entitled "Limitation on Patent Right," which deals with the questions of compulsory licenses and the annulment of contracts containing restrictive conditions. Parts II and III of the book treat respectively of copyright in design and of trademarks. The volume is provided with a table of cases cited and with a rather copious index. To persons unfamiliar with the theory of British patent law, one sentence may be rather startling: "A person who is merely the first to introduce an invention into England, stands on an equal footing with an inventor as regards his eligibility for a patent."

George W. Watts

George W. Watts, who has been connected with the Niles Tool Works, and subsequently with the Niles-Bement-Pond Company, for the past 22 years, died at his home in Philadelphia on April 7, in his 63d year.

Mr. Watts learned his trade as machinist, draftsman and designer of boilers, engines, and machinery with the I. P. Morris Company, in which company he rose to be chief draftsman and designer. Before entering the employ of the Niles Tool Works, in 1888, as eastern sales manager, he was chief draftsman of the Dixon Manufacturing Company, Scranton, Penn.

PERSONALS

Items For This Column Are Solicited

W. S. Davenport, treasurer and general manager of the Davenport Machine Tool Company, New Bedford, Mass., sailed for Germany on April 19.

F. J. Smith, president and manager of the S. W. Card Manufacturing Company, Mansfield, Ohio, sailed on the "Mauretania" on April 13, for a trip broad.

W. C. Wilcox, for a number of years connected with the Reeves Pulley Company, has been appointed manager of that firm's Chicago branch, to succeed E. O. Winterowd, resigned.

Charles E. Sweet, superintendent of the steam turbine department of the Westinghouse Machine Company, has resigned in order to accept a position with the E. M. F. Company, Detroit, Mich.

Philip G. Darling, until recently on the engineering staff of Manning, Maxwell & Moore, is now with the E. I. du Pont de Nemours Powder Company, Wilmington, Del., engaged in development work.

H. F. Stimpson, until recently conducting a consulting engineer's practice, has become associated with the Universal Audit Company, New York City, as its chief engineer in charge of the design and development of efficiency in industrial plants.

Jacob Bock, formerly machine-shop foreman of the Dayton Hydraulic Machinery Company, which recently suspended business, has accepted the position of factory manager of the E. B. Van Wagner Manufacturing Company, Fayetteville, N. Y.

James A. Brown, who has been employed for the past five years as a constructing engineer in the Ordnance Department of the U. S. Army, has resigned his position to engage in general engineering work in Philadelphia. Mr. Brown will also represent several manufacturers of machine-shop equipment.

Percy C. Day, who has been in charge of the Power Plant Company, of London, England, and known to our readers as the author of the article on machine-cut double-helical gears, expects to arrive in this country within the next 60 days. He is to be in charge of the gear-cutting department of the Falk Company, Milwaukee, Wis., which firm has acquired the American rights owned and controlled by C. Wüst, on his double-helical gears and gear-cutting machinery.

New Tools *and* Machine Shop Appliances

Showing New Ideas *in* Machine Shop Equipment *that* make *it* possible *to* do better work at a reduced cost

An Arch Type Transfer Press

ANY new or improved machine or shop appliance of interest to our readers will be illustrated and described in this department.

A full and more detailed description will be given—when of special interest and it appears here before being sent elsewhere.

ALL descriptions appear in all four editions of the paper—Weekly, Monthly, Weekly English and Weekly German.

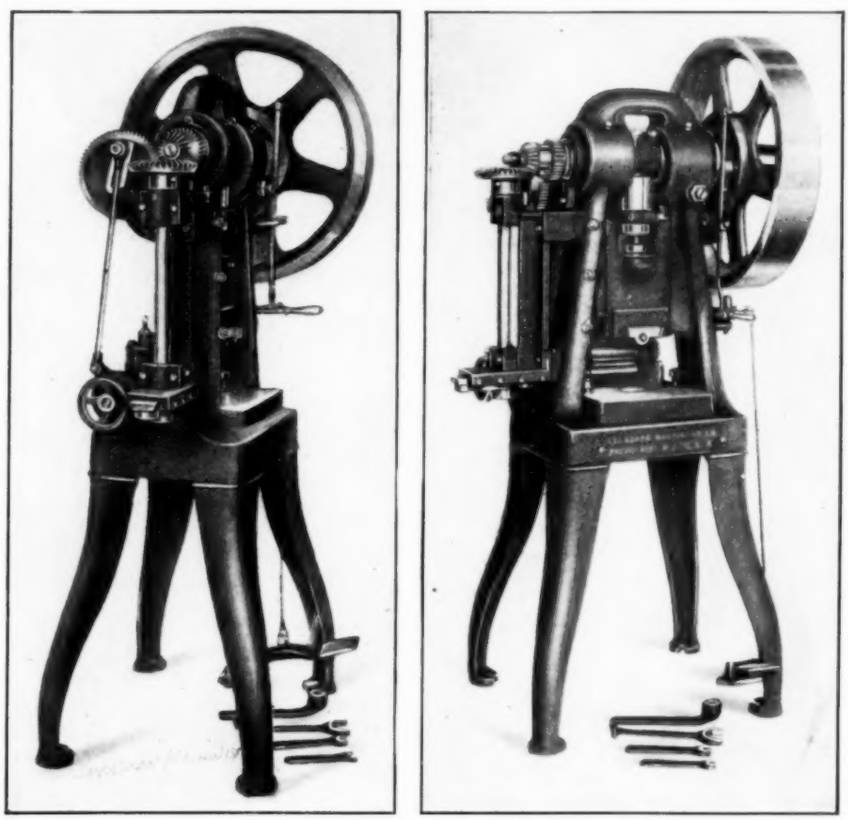
The halftones, Figs. 1 and 2, show side and front views of a new line of transfer presses which have recently been put on the market by the Standard Machinery Company, 7 Beverly street, Providence, R. I. The line comprises at present four sizes weighing from 700 to 4200 pounds, the one shown being the second size and weighing 1400 pounds. The machine is equipped with the Horton instantaneous friction clutch. The transfer arrangement is operated by the bevel gearing on the left side of the press, which transmits motion from the end of the crankshaft through the vertical shaft to a cam on the end of it. With it a throw of from 1 to 3 inches is obtainable and cutting and drawing operations can be accomplished at one stroke of the press.

Geared direct to the end of the crankshaft which actuates the transfer mechanism is the slotted disk for the roll feed. This feed is operated either by ratchet or friction and consists of two rolls 2¼ inches diameter by 5½ inches face, allowing the machine to take stock up to 5¼ inches wide.

A special feature which is new in the feeding of stock is the adjustable connecting rod from the roll-feed slotted disk to the ratchet housing. This does not appear in the halftones, but is clearly shown in the line cut, Fig. 3. *A* is a sleeve which controls the distance necessary for the plunger to travel before the feed goes in action; *B* is the spring; *C* the sleeve for the spring; and *D* the rod which acts as a plunger. It will be readily seen that when the machine is in motion and the crank of the press starts to travel the gear which actuates the roll-feed rod travels around until the plunger of the connecting arm comes to a seat as shown in Fig. 3. This mechanism is exceptionally advantageous in light cutting, drawing, embossing and swaging. It is applicable to hardware, jewelry and general work.

With this arrangement the distance the plunger travels, before the feed starts, can be controlled absolutely, which is particularly advantageous when the machine is used for cutting and drawing.

The press shown has a stroke of 1¼ inches; adjustment of slide, 1⅜ inches; distance between uprights, 12 inches; distance from slide to bolster with slide down and adjustment up 5½ inches; bottom of slide 3½x6¼ inches; bed, 22 inches wide by 15½ inches deep; floor space required, 24x30 inches; usual speed about 140 revolutions per minute.



FIGS. 1 AND 2. AN ARCH TYPE TRANSFER PRESS

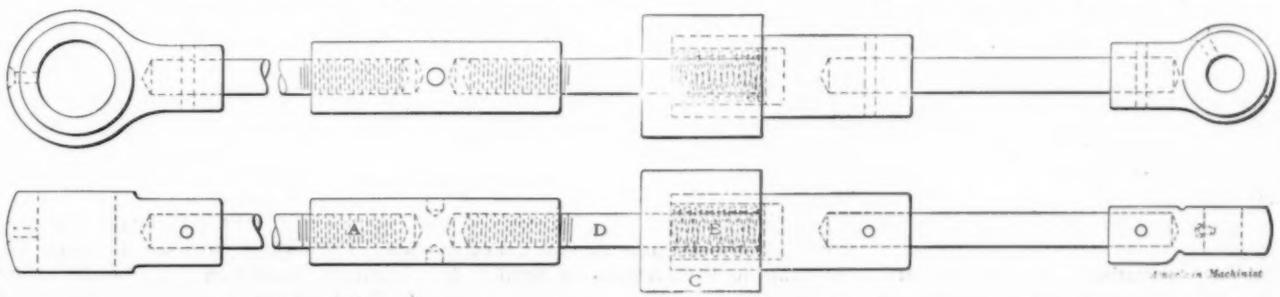


FIG. 3. THE ADJUSTABLE CONNECTING ROD

Automatic Clock Pinion Turning and Drilling Machines

The accompanying halftones illustrate some very interesting automatic machines built by the Davenport Machine Tool Company, New Bedford, Mass., for turning and drilling lantern pinions used in clocks, the turning machine being adapted also for making other kinds of pinions such as are used in steam and other pressure gages, mechanical toys, etc., and, in fact, for handling any work of similar nature requiring an unusual number of forming tools as with the extra turret referred to below, seven forming and cutting-off tools can be used.

The automatic turning machine is illustrated by Fig. 1, and the sequence of operations from the feeding of the stock to the cutting-off of the completed piece is represented clearly in Fig. 2. The general character of the machine with its cam shaft, drums and disks, controlling levers, etc., is indicated by the general view, Fig. 1, which also shows the special magazines upon the turret from which the collets or brass disks are automatically fed down opposite the chuck and forced into place upon the pinion shafts machined in the work spindle. The main spindle is driven by a five-step cone giving the necessary range of speeds and the cam shaft is driven from clutches and gearing at the rear which is so arranged that the idle or noncutting movements are performed very rapidly, while during machining operations the mechan-

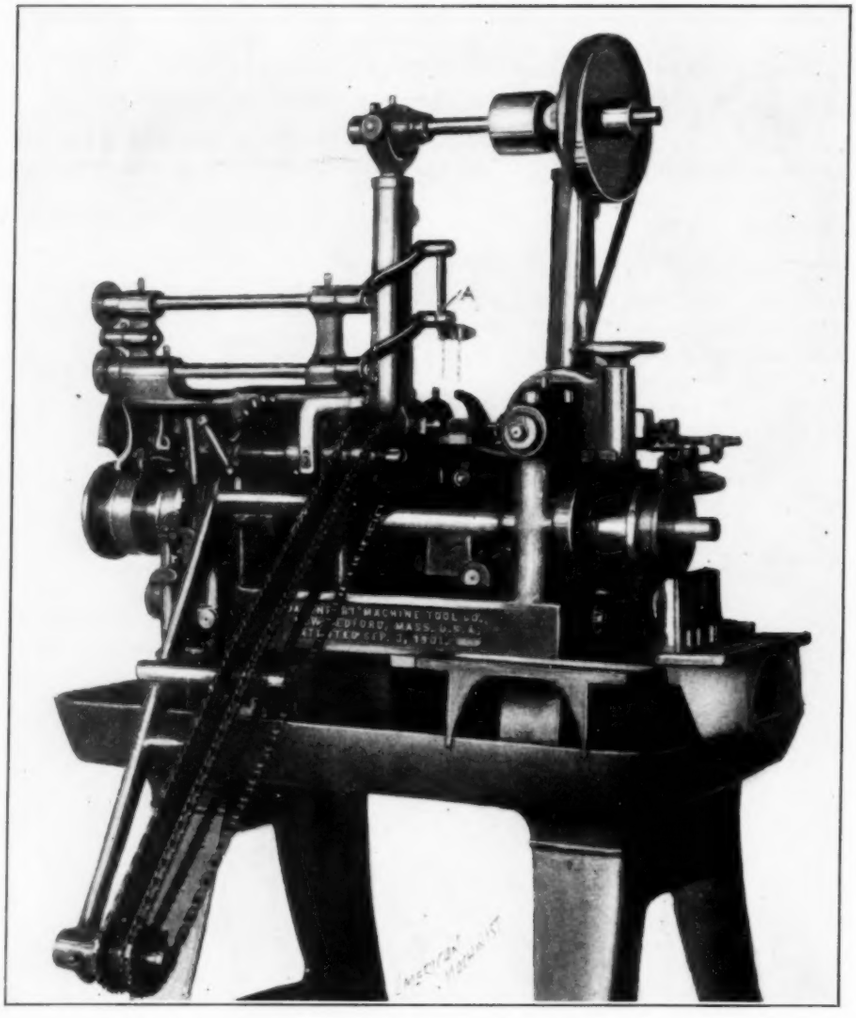


FIG. 3. PINION DRILLING MACHINE

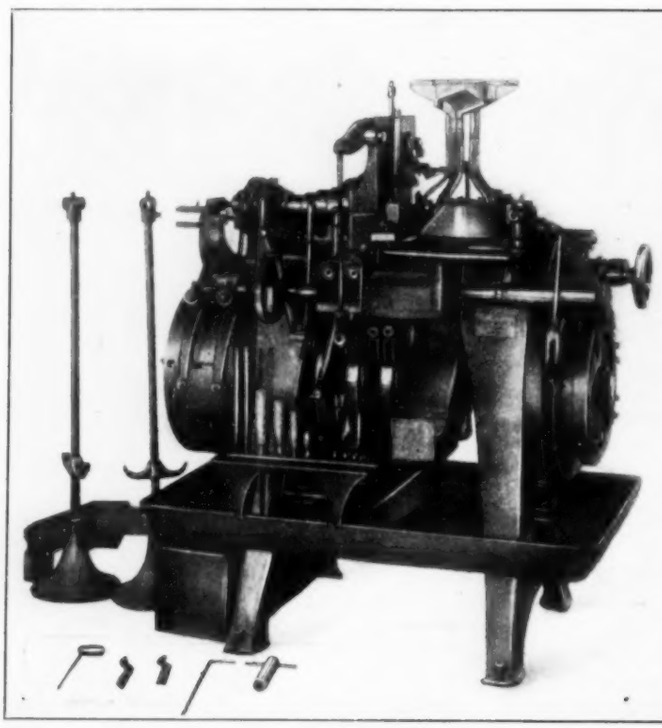


FIG. 1. AUTOMATIC CLOCK PINION TURNING MACHINE

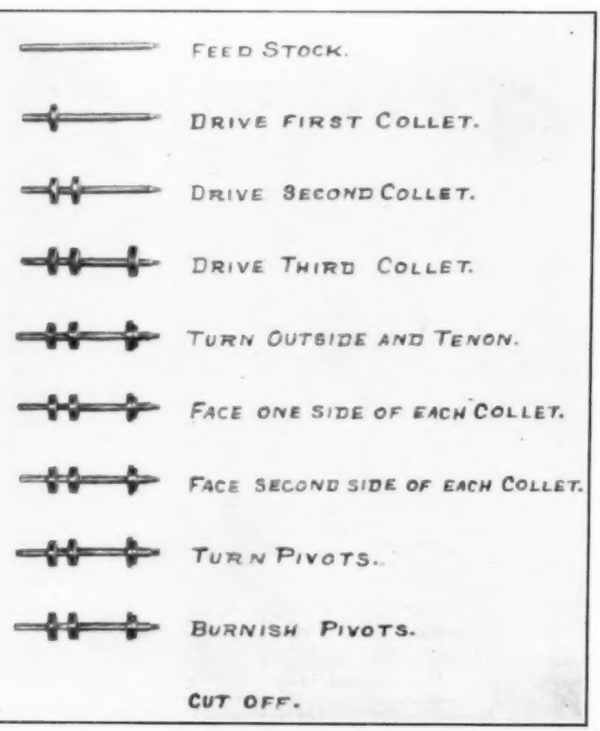


FIG. 2. OPERATIONS IN MAKING CLOCK PINIONS

ism is slowed down to whatever speed may be necessary.

The light steel rod for the pinion shafts is passed through the spindle in the usual manner, the pivot at the outer end of the piece being formed simultaneously with the inner pivot of the shaft cut off just before the feeding of the stock for the next shaft. The brass collets or disks are blanked from sheet stock and a hole is punched through the center which is slightly smaller than the diameter of the steel piece upon which the disks are to be forced. After the stock feeds out, one of these disks is pressed on by the turret advancing rapidly and the turret then recedes and advances again to force the second disk into place as shown by the operations represented in Fig. 2. The pinion is shown with three collets and the third one is forced into place when the turret has been indexed to bring the second magazine into position opposite the spindle. The diameters of the collets or disks are turned by a swinging box tool carried in the turret and operated by movement of the cross slide which swings the tool into cutting position. In this same operation the tenon or hub on the side of the outer or larger disk is also turned. This hub is intended for the reception of a larger gear which is set in place against the face of this disk.

As will be noticed upon inspection of the general view, the machine is fitted with a vertical slide which carries five tools, which are indexed around by the movement of the machine. The first set of tools to operate with this vertical slide face off one side of each of the three disks. The tools in the next position face the opposite sides of the disks to proper thickness. Forming tools are carried on the front and rear cross slides, the tool at the back rough forming the pivots and the tool in front taking the finishing cut on the pivot. In the next operation the pivots are burnished with a wheel carried on the vertical slide above the chuck. The fourth tool on this vertical slide cuts down the neck between the rear end of the pivot which has just been operated upon and the front end of the stock projecting from the chuck, and the fifth tool on the vertical slide cuts off the finished shaft. During the series of operations performed with the cutting tools on these pinions, the outer end of the work is supported by a device carried in the turret.

A wide range of speeds for the tool-feeding mechanism is obtained by means of the grooved cone pulley at the left of the machine head and by suitable change gears. The transfer of the collets or disks from the magazines to the shafts upon which they are pressed is effected by a simple device which carries each disk forward at the proper time and presses it quickly and firmly onto the steel rod. During this operation the spindle is stopped and this is accomplished instantaneously by a friction brake automatically applied at the right-hand end of the driving cone upon the spindle. The pinion illustrated in Fig. 2 is a typical form, one of a great number of types varying in different features in accordance with the requirements of clock manufacturers.

Pinion Drilling Machines

The machine in Fig. 3 drills the holes in the pair of disks on the pinion shaft to receive the wires which make up the lantern teeth when completed. The blanks assembled and ready for drilling are placed on the chain conveyer in front of the machine. This is a device which may be swung up to any convenient angle. From the pockets in the chain which carry the pinions upward they are lifted one by one by a pair of fingers, operated by rockers *A* which pick the pinion from its pocket in the chain and carry it toward the back of the machine where it is deposited in a chuck in a spindle. This spindle is fitted with suitable indexing mechanism by means of which the work is rotated step by step so that a drill carried in a spindle longitudinally opposite the work spindle can be advanced to drill the holes required through the two disks for the pinion. The mechanism of the machine is readily adjusted to accommodate different sizes of work and to drill different numbers of holes in the disks.

Arch Press with Wedge Adjustment

The halftones illustrate an arch press with wedge adjustment built by the Blake & Johnson Company, Waterbury, Conn. The general view, Fig. 2, shows the press clearly with a subpress in position for operation. While the hand wheel for adjusting purposes is seen at the front, the view, Fig. 1, shows the arrangement more clearly. As will be observed upon examining this engraving, the wedge adjustment is in the nature of a double dovetail, so that there is no lost motion in the gate. This construction also permits the tools to be very readily adjusted by the operator, while the press is in operation if necessary. The press is made in seven sizes and automatic friction roll feeds are readily attached whenever desired.

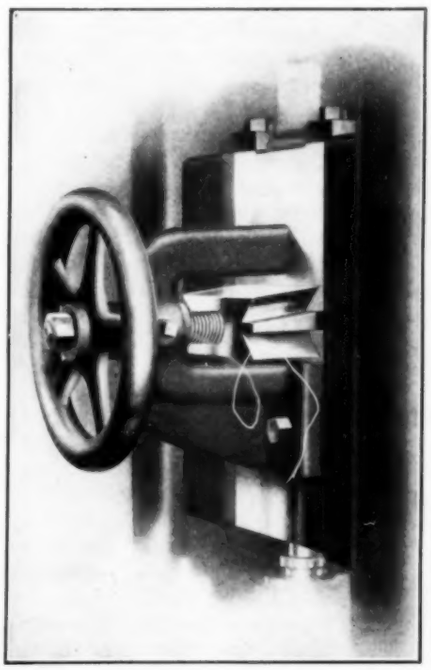


Fig. 1. The Adjusting Device

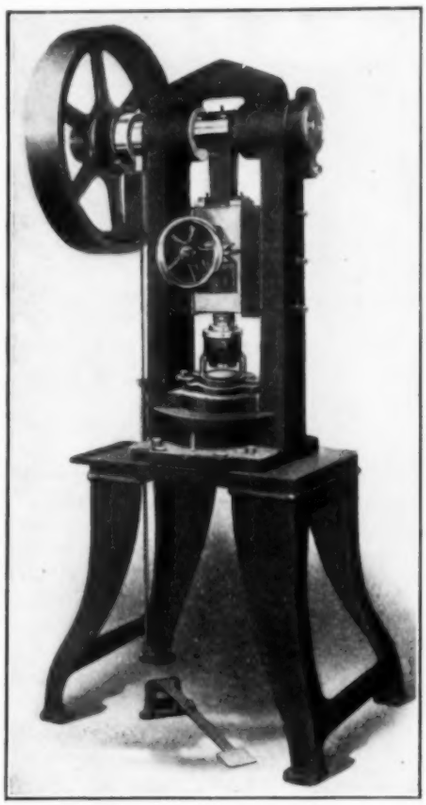


Fig. 2. Arch Press with Wedge Adjustment

Catalogs Wanted

The following notice appears in the April 5 issue of the *Patent Office Official Gazette*:

"This office would be pleased to receive from manufacturers and publishers such catalogs, circulars, price lists, or other advertisements relating to the sciences and mechanical arts as are published by them for gratuitous distribution. It is requested that at least three copies of such publications be forwarded in order that the subjects may be properly indexed, classified and subclassified in the Scientific Library for convenient and ready reference."

National Metal Trades Convention.

From Page 750

ficient time to stimulate their intelligence, arouse their ambition, develop self-control and implant right ideals of working and living. I therefore advance the general proposition that all youths who go to work should be required to continue their education under expert teachers until they are 18 at least.

But I want to consider especially the importance of instruction when a youth fixes upon a life occupation or enters a trade. Upon examination we find that the schooling of apprentices varies from the second or third grade of the elementary school up. Some of them do not know the multiplication table and cannot spell the days of the week. The average attainment is not above the sixth grade, which is reached by a normal child when he is 12. It is not reasonable to expect such youths to make much headway in the intricacies of a trade without expert guidance. They may push a tool or run a machine in time, but they will not probably master a tool or a machine. They feel their brain growing numb as their muscles set in a groove. They either sink to the level of a machine, or rebel and then we hear the employers prate about the degeneracy of modern workmen, the need of intelligence, of serious purpose, of the inventive spirit, of pride in good work—in short, the need of honest, skilful, earnest, judicious men in our industries. Well, then make them. It can be done without doubt. Put one-tenth of the net profit of your shops back into the education of your apprentices and it will bear fruit tenfold in ten years.

But I am not pleading for the sake of the employers. We owe it to our young workmen, to your apprentices, that they shall have the knowledge of those arts and science which will give them interest and insight into their occupation, and especially that they shall have that instruction which will develop their initiative and artistic ability to the end that the young workmen of America shall not be mere operatives or hands, but masterful craftsmen whose alert minds find expression through skilled hands.

I am not pleading for better pay for apprentices. In their early years the pay they get is not so important as the help they get, the interest they acquire, the outlook ahead, the exercise of their minds on problems of the shop, the comprehension of the relation of what they are doing, and in general, the awakening of their ingenuity and intelligence. Your boys need an intellectual plunge bath at least once a week. They need to come into frequent and vital contact with a teacher who is a live wire—a man who knows their troubles and their possibilities, and who is the best man in all the city to awaken their powers. Under such instructors I have seen dull, sluggish, ill-disposed boys, whose visages were frozen into a perpetual grouch, thawed out in a few months, so that there was elasticity in their step, confidence in their voice, and determination in their eye. We hear about the conservation of national resources. I plead for the conservation of our greatest national asset—the young workman. I plead for his right to be an intelligent worker—a conscientious worker—a competent worker—and then a well paid worker with a home of his own and the comforts of life.

Some have thought the solution of the apprentice problem is the trade school where the youth may learn his trade under expert direction and go out to the commercial shop nearly fledged and with enough momentum to carry himself through.

A much more promising method is the coöperative plan of week-about in school and shop. Thus the boy can get his shop experience in natural conditions. In several places this plan is being tried out and the reports that I have received lead me to believe that under favorable conditions it is worthy of attention of boards of education as well as of manufacturers. Cincinnati has been a pioneer in this work in the university, and it is to be introduced in the industrial department of her high schools. But the rank and file are scarcely touched by such a system. The great army of young workers who have been gathered up hither and yon, what shall be done for them? That is the problem to solve. The night school fills a need with older workmen but the apprentice is a day-time proposition. He must come regularly and through a series of years. The employer must make it worth his while to come, and, in fact, must see that he does come.

These ideas ripened in the minds of some of our wisest Cincinnati manufacturers and thus it came about that the Board of Education of Cincinnati last summer proposed to offer continuation courses for apprentices in any trade and proceeded to open a school for machine-shop apprentices as soon as 150 students were guaranteed. More than 200 students were registered by 18 manufacturers and the school started September 1. A man was placed in charge who had been a teacher, a practical shop man, and for many years an instructor of apprentices. He trained his own assistant. The average attendance has been 180 per week. The boys came four hours per week, a new squad coming each half day. The employers pay them for their time and if they do not show up at school they are reported and docked. The school runs 48 weeks a year, 8 hours a day, 4½ days a week, and the instructors spend two half days a week besides visiting the boys in the shops, talking with the foreman and keeping a line on the needs of the boys. The school is costing the Board about $15 a year per boy. The end of all this is not, as some suppose, simply to send him back next day able to turn out more and better work, it is to awaken his dormant powers and make him alert, thoughtful, original, competent up to the limit of his ability.

These mental exercises relieve him of the monotony of shop routine. As he learns of the great industry in which he is engaged and of its captains and inventors, and as he discusses its relations with other occupations and with human life, his interest in his work increases and he comes into sympathy with the great body of the world's workers. As he learns to find new problems in his shop experience and applies his knowledge to them, his work becomes transformed into a fascinating art. He ceases to be a mere hand, and aspires to be a free master of an honorable craft.

We think so much of the plan in Cincinnati that the Board of Education has offered to open a continuation school for any other classes of apprentices that may be sent and also for young saleswomen in stores or girls working in trades. A bill is now before the Ohio State Legislature empowering Boards of Education to require the attendance of all youths under 16 at part-time continuation schools. If I had the determining of it, there would be a law requiring the attendance of all apprentices through their apprenticeship. Such schools will do much to elevate the standards of work, the degree of intelligence and the moral character of young workers, and will lift them in the scale of living so that they may be what they should be—the strength of our nation and the envy of the world.

* * *

The continuation school is attended by some 200 apprentices of varying age, employment and scholastic attainment. The majority come from the machine shop; the pattern shop is represented by a score and the drafting room sends a dozen. Some have a high-school education, while others of the immigrant class are not familiar with English, and still others have not much more than an ability to read and write. They all must have attained the age of 16 years.

The nine sessions per week makes it possible to have nine grades of school work if that were desirable, but the fact that no two boys are sent from the same department at the same time and that a classification according to age in service is preferable for the first year or so, has

materially influenced the course of study and gradation. Odious comparisons are avoided by teaching the beginners some of the more advanced lessons and the older apprentices who come later in the week some of the easier and more important lessons. This inconsistency will take care of itself as the older apprentices graduate. The lessons are of a nature which permits of personal instruction, although class work is preferred when possible, as is nearly always the case.

The work of each student is kept in an envelop under his own name, and this envelop is given out at the beginning of each lesson and filed in a cabinet at the close of each lesson. Many valuable blueprints are also filed in the same manner. The manufacturers have provided the school with 25 copies of suitable blueprints and these serve for lessons in reading of drawings, etc. The library of the school is made up of catalogs (25 copies each) of the various manufacturers, and they serve for reading, spelling, etc. Text books are provided by the Board of Education.

When these text books fail to interest the apprentices, lessons were prepared and styled "jigs." A lesson is prepared by the instructor and just so much of the lesson is traced on tracing cloth as will save the apprentice doing unnecessary mechanical preparation. This tracing is used to make a brown print and the brown print is used to produce a print having a white background with blue or black lines. Twenty-five copies of this are made and given out for a lesson. The lesson consists in filling in the missing parts, which necessitates instruction in the principle of the lesson and subsequent exercise in its application on the part of the apprentices. The time saved to the apprentice is enormous and the only effort on his part is along the line of the principle. The lesson paper contains sufficient exercises to produce skill as well as knowledge.

Three lessons cover the course in arithmetic, algebra, geometry and trigonometry in mathematics, and while there is the usual sequence of principle, the lessons are far different from the arithmetic as known to the general scholar.

Shop spelling is not overlooked and the "parts lists" of the master machinists' tools, such as lathes, planers, drill presses and milling machines, etc., are numbered and the names are written from memory as the special part is pointed to or number called. The names of such products as screws, tongs, hammer dogs, wrenches, etc., are given out and the article sketched as well as spelled. The importance of this work cannot be over estimated, since *profanity is an indication of lack of vocabulary*, and an apprentice should learn early to call things by their legitimate name.

The geography of iron, coal, etc., together with their history and relation to commerce comprise an apprentice's early reading, and is followed by enough science of steel, etc., to bring out the law and order of the universe for the purpose of developing a wholesome respect for the many sacrifices which organization and production on a large scale necessitates.

Natural philosophy of a popular nature, mechanical drawing, debate, composition, etc., furnish a means of developing executive ability so much in demand. An interesting collection of spoiled work is being brought in and a detailed description of the cost of material, time on work, etc., is written in a little composition book, and attached to the piece much like a tag. This will serve as a caution to apprentices for years to come and should be a valuable asset of the school when a quantity of it is cataloged.

The two half days a week which the instructors spend in the shops is productive of common good. The boys appreciate an interest in their welfare and the contact with the shops held the instructor to remain practical if not skilled. The foreman has and takes advantage of the opportunity to question and advise and herein lies the success of the school. The instructor is able to diffuse useful information and keep alive a friendly rivalry, while taking care of petty antagonism or cases of negligence.

Success in a continuation school is spelled with the letters of two words—*friendly foremen*. It takes gilt-edged results to win them and the fact that they have been gradually won over to the idea of a school which takes the apprentices away from them for a half day each week in order to increase production is proof of the success of the school.

Monthly Meeting of American Society of Mechanical Engineers

The April meeting of the American Society of Mechanical Engineers held in the society's building on the evening of April 12, was one of the most important that has been held for some time, in regard to its direct application to the machine shop. The general subject was electric drives in machine shops, and the meeting was conducted with the coöperation of the American Institute of Electrical Engineers. Four papers were presented to a large assembly and the following discussions were interesting, pertinent and at times amusing. The papers presented were: The Economy of Electric Drives, by A. L. DeLeeuw; Economical Features of Electric Motor Applications, by Chas. Robbins; Mechanical Features of Electric Driving, by John Riddell; and Selections of Methods of Applications of Motors and Controllers, by Charles Fair.

Mr. DeLeeuw's paper has been before the engineers for some time as it was published in the November, 1909, issue of the *Journal*. Mr. Riddell's paper we abstracted at considerable length in our last week's issue, beginning on page 701. Mr. Robbins' paper appears in this issue somewhat condensed. Much of the engineering material forming appendices to this paper will be given in succeeding issues.

Mr. Fair's paper illustrated a large number of motor applications for machine tools, dwelling especially on the location of the controllers and the operating handles and levers. He presented a table showing in a general way what type of motors should be selected for a lengthy list of machine tools. This table we reproduce.

Discussions

The discussions were animated. Mr. Hess took up the subject under the three headings, convenience, first cost and operation. He presented data taken from the experience of the Link Belt Company, of Philadelphia, tending to show some of the claims made for economy in electric drives are not worked out in practice.

Mr. Pomeroy discussed the subject from the standpoint of railroad shops. Vice-president Eberhardt, of the Machine Tool Builders Association, referred to the work of their committee which is cooperating with a similar committee of the Motor Builders Association, with the view of standardizing, as far as may be possible, electric motors for machine tools. He laid down as desirable, that the motor proportions as regard size of feet, the distance from the plane of the feet to the axis of the armature shaft, diameter of pulley shaft, size of keyways, etc., and speed, should be standardized.

He was followed by Mr. DeLeeuw, who is a member of the committee to which Mr. Eberhardt referred. Mr. DeLeeuw said that a meeting was held about two weeks previous in coöperation with the committee of the Motor Builders Association. Many points were brought up for discussion and the committees agreed on a few although these by no means cover the entire list of proportions, etc., which the committees will ultimately consider. In regard to horsepower the recommendation is for the following sizes: 1, 2, 3, 4, 5, 7½, 10, 15, 20 and 25 horsepower. In both alternating-current and direct-current motors, and a 1½-horsepower size in direct-current motors. It was thought that these sizes would be generally suffi-

cient to cover the range of machine-tool requirements, and that it was inadvisable to attempt to carry the standardization to sizes larger than 25 horsepower.

In regard to voltage the recommendations at present are only for 110 and 220 volts. The question of ratings was considered as to the data appearing upon the motor name plate and the performance of the motors in regard to heating and the carrying of loads for specified periods. The question of adjustability of speed for direct-current motors stopped with a recommendation for the 1 to 2 and the 1 to 3 ratios. No standard for other ranges or greater ranges were deemed advisable at this time.

Mr. Barth took exception to either the implied or stated opinion that belts are unreliable, and was very emphatic in stating that properly designed belts will give speeds that will not vary more than 1½ to 2 per cent. from normal and that he was unable to get motors that would do as well.

Mr. Robbins' paper was spoken of in the highest terms by several of the members who joined in the discussion, as being an unusually clear and comprehensive presentation of the principles underlying the application of electric motors to machine-shop uses.

This brief report should not close without an expression of appreciation for the efforts of the meetings committee in arranging for this symposium on such a vital machine-shop problem.

Tool.	Direct Current.			Alternating Current.		
	Shunt.	Comp.	Series.	×	‡	*
Bolt cutter	†			×		
Bolt and rivet header		20% 40%		×	‡	
Bulldozers		20% 40%		×	‡	
Boring machines	†			×		
Boring mills	†			×		
Raising and lowering cross rails on boring mills and planers		40%	†		‡	
Boring bars	†			×		
Bending machines		20% 40%		×	‡	
Bending rolls		40% 80%	†			*
Corrugating rolls		20% 40%		×	‡	
Centering machines	†			×		
Chucking machines	†			×		
Boring, milling and drilling machines	†			×		
Drill, radial	†			×		
Drill press	†			×		
Grinder—tool, etc	†			×		
Grinder—castings		20%		×		
Gear cutters	†	20%		×		
Hammers—drop		20% 30%			‡	
Keyseater—milling—broach	†			×		
Keyseater—reciprocating		20%		×		
Lathes	†			×		*+
Lathe carriages			†		‡	
Milling machines	†			×		
Heavy slab milling	†	20%		×		
Pipe cutters	†					
Punch presses		20% 40%		×	‡	
Planers		20%		×	‡	
Planers—rotary	†	20%		×		
Saw—small circular	†			×		
Saw—cold bar and I-beam		20%		×		
Saw—hot		20%		×		
Screw machine	†			×		
Shapers		20%		×		
Shears		20% 40%		×	‡	
Slotters		20%		×		
Swaging		20%		×	‡	
Tappers	†			×		
Tumbling barrels or mills		20%		×		

× Squirrel-cage rotor. ‡ Squirrel-cage rotor—high starting torque. * Slip-ring induction motor with external rotor resistance. + Might be used for tire lathes as it allows slowing down when cutting hard spots.

MOTORS FOR MACHINE TOOLS.

FORTHCOMING MEETINGS

International Railway General Foremen's Association, annual convention, May 3-7, Grand hotel, Cincinnati, Ohio. L. H. Bryan, secretary, Two Harbors, Minn.

National Association of Manufacturers, annual meeting, Waldorf-Astoria hotel, May 16, 17 and 18, 1910. Geo. S. Boudinot, secretary, 170 Broadway, New York City.

National Machine Tool Builders' Association, spring convention, May 24-25, Rochester, N. Y. Charles E. Hildreth, Worcester, Mass., secretary.

American Society of Mechanical Engineers, spring meetings, Atlantic City, N. J., May 31-June 3. Calvin W. Rice, secretary, 29 West Thirty-ninth street, New York City.

American Foundrymen's Association and American Brass Founders Association; joint convention, June 7-8-9, Detroit, Mich.; headquarters, Hotel Pontchartrain. Richard Moldenke, secretary, Watchung, N. J.

National Gas and Gasolene Engine Trades Association. Semi-annual convention, Cincinnati, Ohio, June 13-16, 1910; headquarters, Hotel Sinton. Albert Stritmatter, secretary, Cincinnati, Ohio.

Master Car Builders Association; annual meeting June 15-17, Atlantic City, N. J. J. W. Taylor, secretary, Old Colony building, Chicago, Ill.

American Railway Master Mechanics Association, June 20-22, Atlantic City, N. J. J. W. Taylor, secretary, Old Colony building, Chicago, Ill.

Joint meeting of American Society of Mechanical Engineers and Institution of Mechanical Engineers, Birmingham, England, July 26-29, 1910.

American Society of Mechanical Engineers; monthly meeting second Tuesday. Calvin W. Rice, secretary, 29 West Thirty-ninth street, New York City.

Boston Branch National Metal Trades Association. Monthly meeting on first Wednesday of each month, Young's hotel. D. F. P. Clark, secretary, 309 Milk street, Boston, Mass.

Providence Association of Mechanical Engineers. Monthly meeting fourth Tuesday each month. E. C. Bliss, president, 91 Sabine street, Providence, R. I.

New England Foundrymen's Association; regular meeting second Wednesday of each month, Exchange Club, Boston, Mass. Fred F. Stockwell, 205 Broadway, Cambridgeport, Mass.

Engineers' Society of Western Pennsylvania; monthly meeting third Tuesday. Elmer K. Hiles, secretary, Fulton building, Pittsburg, Penn.

Superintendents' and Foremen's Club of Cleveland; monthly meeting third Saturday. Phil. Frankel, secretary, 310 New England building, Cleveland, O.

Western Society of Engineers, Chicago, Ill. Regular meeting first Wednesday evening of each month, excepting July and August. Secretary, J. H. Warder, 1735 Monadnock block, Chicago, Ill.

Increasing Shop Capacities
Where More Tools will be needed

The Ideal Bed Company, of Cleveland, Ohio, is to erect a plant at Elyria.

Fire destroyed the sawmill and yards of J. J. Konop, at Wayside, Wis.

Swift & Co., Jersey City, N. J., will build a new refrigerating and power plant.

The St. Louis (Mo.) Car Company is making preparations to increase its capacity.

The factory of the Don Iron Works Company, Toronto, Ont., was destroyed by fire.

The brass foundry of John Riffa, St. Catharines, Ont., was burned. Will be rebuilt.

The plant of the Rich Pump Company, Cincinnati, Ohio, was completely ruined by fire.

The Standard Chemical Company, of New York, is to erect a factory at Bayonne, N. J.

The B. F. Shaw Company, Wilmington, Del., is to build an addition to its boiler shop.

The Edgerton (Wis.) Wagon Company, recently organized, is to erect a modern factory.

The plant of Russel Brothers, machinists, St. Catharines, Ont., was burned. Will be rebuilt.

The plant of the Hassell Iron Works, Idaho Springs, Colo., was burned. Loss, about $20,000.

The Montreal (Que.) Steel Works, Ltd., is preparing plans for an extensive foundry building.

The Wisconsin Light and Power Company, Birchwood, Wis., is planning to increase its capacity.

J. G. Pye, W. Poole and John F. Harrison contemplate installing a water plant at Bienville, La.

The Crocker-Wheeler Company, of Ampere, N. J., is erecting a large factory at St. Catharines, Ont.

The Wausau (Wis.) Paper Company is to spend $50,000 in improvements on its plant at Brockaw.

The plant of the Peerless Cash Register Company, St. Catharines, Ont., was burned. Will rebuild.

A four-story addition is to be built at the plant of the National Straw Works, Milwaukee, Wis.

The Kinder (La.) Ice, Light and Water Company, recently incorporated, will erect a $25,000 plant.

The Lobee Pump and Machinery Company, Buffalo, N. Y., will erect a new two-story factory building.

Construction has been started on a new mill for the World's Star Knitting Company, Bay City, Mich.

The Garrett (Ind.) Paper Mill Company is erecting a building for the manufacture of paper from peat.

It is reported the Republic Metalware Company, Buffalo, N. Y., is to build a large addition to its plant.

The Eldorado (Ark.) Electric Light and Water Company will install an additional engine and generator.

Fire destroyed the typewriter plant of the Acme-Keystone Manufacturing Company, Beaver Falls, Penn.

The Van Brunt Manufacturing Company, Horicon, Wis., manufacturing seeders, will erect a new factory.

The Whitaker-Glessner Company, of Wheeling, W. Va., is to erect a steel plant at Martin's Ferry, Ohio.

Authentic news is solicited for this department. Real opportunities for the sale of machinery of any kind.

The Wayne Works, Richmond, Ind., making agricultural implements, is preparing plans for a foundry building.

The Big Four Railroad is now letting contract for the construction of its new shops near Indianapolis, Ind.

The Columbus (Wis.) Canning Company will erect four new buildings to be equipped with modern machinery.

The Rochelle (Ill.) Clock Company will move its plant to Columbus, Ohio, having outgrown its present plant.

The Taylor Instrument Company, Rochester, N. Y., is to erect two additions to its plant at a cost of about $11,000.

The National Seed Corn Tester Company will locate at Des Moines, Iowa. Plans for factory are being prepared.

The American Motor Car Company, of Indianapolis, Ind., has completed plans for a new plant at Lafayette, Ind.

The plant of the Cisler Brick Company, Marietta, Ohio, was burned. Will be rebuilt and new machinery installed.

The cooper shop of the Illinois Barrel Company, 3831 Butler street, Chicago, Ill., was burned. Loss, about $10,000.

The Bemis Brothers Bag Company, St. Louis, Mo., will erect a seven-story factory building at a cost of $100,000.

The Griffin Wheel Works, Denver, Colo., has secured permit for a one-story manufacturing building to cost $40,000.

Wm. F. Read & Sons Company will build a large weaving factory at Twelfth and Jackson streets, Philadelphia, Penn.

The J. H. Hanes Knitting Company, Winston-Salem, N. C., will erect a new mill which will have about 10,000 spindles.

The Copley Square Hotel, Boston, Mass., is contemplating replacing its present boilers in main building with new ones.

The Forest City Mill and Lumber Company, Cleveland, Ohio, is in the market for a 16x36 second-hand Corliss engine.

The Santa Fe Railroad is to erect an 18-stall roundhouse and double the capacity of its machine shop at Clovis, N. M.

The John A. Stewart Electric Company, Cincinnati, Ohio, has purchased factory site at Red Bank, a suburb of Cincinnati.

The Union Iron Works Company, Limited, has secured site at Parry Sound, Ont., for the erection of machine shop, foundry, etc.

The Frontier Mining Company, Benton, Wis., is planning to construct a power plant and to install concentrating machinery.

Bevin Brothers Manufacturing Company, East Hampton, Conn., will erect a power house to be operated by water wheel.

The Pottstown (Penn.) Motor Car Company will extend its plant and install machinery for doing all kinds of repairs.

The Oriental Metal Bed Company, Hoboken, N. J., is having plans prepared for a factory to replace one recently destroyed.

The Bessemer Gas Engine Works, Grove City, Penn., is seeking a location to establish a plant for the manufacture of gas engines.

The North Jersey Traction Company will erect a one-story building at Hohokus, N. J., which will contain power plant and car barn.

Rennous, Kleinle & Co., Baltimore, Md., brush manufacturers, will build a $12,000 addition to its plant at 848 Frederick avenue.

The New York Air Brake Company, 165 Broadway, New York, is to build a new machine shop at its plant in Watertown, N. Y.

Fire destroyed the drafting building of the New York Shipbuilding Company, Camden, N. J., causing a loss of about $100,000.

The Seattle, Renton & Southern Railway is building a new shop adjoining its plant at Columbia, Wash., in which to build steel cars.

The Northway Motor and Manufacturing Company, Detroit, Mich., is to erect four new buildings which will triple its present capacity.

The No. 2 machine shop of the Schofield-Holden Machine Company, Toronto, Ont., was damaged by fire to the extent of about $7000.

The S. & I. Company, Springfield, Mass., manufacturing hardware and plumbing specialties, is planning the erection of a new factory.

The plant of Emmons Brothers, Haverhill, Mass, manufacturers of felt hats, was destroyed by fire, causing a loss of about $50,000.

The Buckeye Steel Castings Company, Columbus, Ohio, is preparing to start the erection of another factory building on its grounds.

The flour mill and elevator of the Maney Milling Company, at Omaha, Neb., were burned. Loss, about $190,000. Plant is to be rebuilt.

The Hanlon & Thornton Manufacturing Company, North Attleboro, Mass., manufacturing jewelers, are looking for a location for a factory.

The Bristol-Myers Company, 277 Greene avenue, Brooklyn, N. Y., manufacturing chemists, are to erect a new six-story factory and warehouse.

The Doty Engine Works Company, of Toronto, Ont., has obtained site in Winnipeg, Manitoba, and will erect machine shop and boiler works.

Sprake & Shonk, 17 Vine street, Plymouth, Penn., are to install a 24-inch lathe, shaper and 3- or 4-horsepower motor, either second hand or new.

The Atlantic Fertilizer Company, Baltimore, Md., is having plans prepared for the erection of a power plant to be equipped with turbine engines.

The Oriskany Ore and Iron Company, of Covington, Va., has secured site at Richmond, and it is said will erect a branch plant to employ 500 men.

The Bridgeport (Conn.) Forge Company has had plans drawn for two new factory buildings to replace its plant destroyed by fire sometime ago.

The assets of the Bennett Steel Furnace Company, of Cincinati, Ohio, have been purchased by H. M. Freeman. A company will be incorporated to carry on the business with improvements.

A large plant for the manufacture of a recently invented machine for baling paper and waste by A. L. Stephenson and Robert K. Davis, of Findlay, Ohio, is reported to be in contemplation.

T. McAvity & Sons, Ltd., St. John, N. B., manufacturing hardware and operating brass foundry, are looking for a suitable site to locate its plant. Six hundred to 1000 hands will be employed.

The Warren City Tank and Boiler Company, Warren, Ohio, is to erect an addition to its plant and will need more equipment, including hydraulic riveting and flanging machines, electric cranes.

The Potter & Johnston Company, Pawtucket, R. I., building automatic chucking machines and universal shapers, contemplates building an addition to its plant to take care of increased business.

The West Manufacturing Company, making metal specialties, and the Kennel Edge Tool Company, both of Columbus, Ohio, having outgrown their present quarters, will probably locate in London, Ohio.

The Mitchell Manufacturing Company, Portsmouth, manufacture vending machines, etc., to shortly move to its new plant and new machinery will be installed. Capacity will be doubled in six months.

A new foundry company is being organized at Springfield, Mass., by Mr. Hale, manager of the Springfield Foundry Company. It is expected that the new company will have buildings completed and turning out work by next fall.

George A. Gross, of Jamestown, N. Y., is forming a company to manufacture automobile wheels, axles and bodies. Mr. Gross has been connected for some time with the Salisbury Wheel and Manufacturing Company, of Jamestown.

The Baird Machine Company, Oakville, Conn., is reported to be investigating throughout the Middle Atlantic and New England sections preparatory to securing a suitable site for the establishment of a large and modern new plant.

The Chadwick Engineering Company, Pottstown, Penn., building the Chadwick automobiles, is outgrowing its present plant and has about decided to remove its plant to some other place offering better facilities for its growing business.

The Whitney Manufacturing Company, Hartford, Conn., manufacturing chains, machine tools, etc., will shortly award contract for the erection of a five-story addition to its plant. This will give an additional floor space of 24,000 square feet.

The Metzger Motor Car Company, Brooklyn, N. Y., is endeavoring to secure a site for a large and modern plant, to be erected as soon as possible. New plant is to be erected for the manufacture of the Hewitt trucks, and is to cost about $200,000.

The Northern Texas Traction Company, Fort Worth, Tex., has completed plans for the construction of a building on East Front street in connection with its present buildings, where it will be able to build its own cars and do all kinds of repairing.

Sealed proposals will be received at the Watervliet Arsenal, Watervliet, N. Y., until 1 p.m., May 16, 1910, for furnishing steel, hardware, oils, etc., during the year ending June 30, 1911. Information can be had of Lieut. Col. W. W. Gibson, commanding.

The American Wood Working Machinery Company, Rochester, N. Y. (export department), is inquiring for a grinder for circular knives from 43/4 to 16 inches in diameter, with bevels varying from 1¼ to 2 inches in length, about ⅛ inch thick for cutting cork.

It is reported that C. E. Capen and C. H. Emery, of Eastport, Me., and C. W. Sleeper, of Lancaster, N. H., are interested in the organization of a new company for the purpose of erecting a large and modern canning factory to be located in the New England section.

It is reported that plans are now being drawn for improvements to cost $5,000,000 at the Benwood, W. Va., plant of the National Tube Company. It is said the present furnaces will be replaced by the open-hearth type and plant enlarged to employ 5000 additional men.

R. A. Stark, superintendent of Beers Brothers Manufacturing Company, Marion, Ind., is at the head of a new concern to be known as the Union Motor Company, to manufacture motors for boats, automobiles, etc. The company will erect a $30,000 building and invest $40,000 in machinery.

It is reported that the Harold Gasoline Traction Company, Marion, Ohio, is considering the removal of its plant to some other town or city, preferably in the Central West. This company has recently invented and perfected a new machine which is to be manufactured and larger and more modern plant is desired for this purpose at once.

The recently organized United States Motor Company, which controls the production of the Columbia and Maxwell cars, has taken over a new plant by acquiring the Alden Sampson Manufacturing Company, of Pittsfield, Mass., a concern which makes commercial vehicles only. It is said that the Pittsfield plant will be materially enlarged.

The main plant of the Union Drawn Steel Company was entirely destroyed by fire on April 9. With those buildings which were not touched it is estimated that the present production will amount to about 50 per cent. of the regular output. Immediate steps will be taken to erect new buildings, etc., and it is expected the plant will be running to full capacity within a very few months.

The Navy Department, Bureau of Supplies and Accounts, Washington, D. C., will open the following bids: April 26—Crucible steel blocks, steel tubes (schedule 2388), hand chain (schedule 2389), electrical supplies (schedule 2387), steel bolts and nuts (schedule 2390), expanding mandrels, hand and machine tools (schedule 2385), hand tools, alundum wheels (schedule 2389); May 10—Worm-geared chain blocks, hand and machine tools (schedule 2394), hand metal punches (schedule 2394), induction motors (schedule 2395), rapid-action motor-driven punch (schedule 2383).

NEW INCORPORATIONS

Arrowplane Manufacturing Company, Boston, Mass. Manufacture aëroplanes. Capital, $25,000. W. M. Hilliard, president.

West Helena Company, Helena, Ark. Construct water, light and heating plant. Capital, $100,000. E. C. Horner, president.

Buckeye Foundry Company, Cincinnati, O. Capital, $100,000. Incorporators, William Gilbert, Albert E. Denison, M. C. Longnecker, etc.

Blynt Manufacturing Company, Ashland, Ohio. Manufacture lubricating pumps. Capital, $100,000. Incorporators, Herbert S. Blynt, etc.

Toledo Garage and Supply Company, Toledo, Ohio. Capital, $5000. Incorporators, Chas. A. Langdon, Alvin C. Jones, Geo. T. Browning, etc.

E. Biglow Company, New London, Ohio. Manufacture tile, brick and sewer pipe. Capital, $75,000. Incorporators, E. Biglow, E. O. Biglow, J. L. O'Hara, etc.

Illinois Spring and Wire Company, Chicago, Ill. Springs, wire and steel products. Capital, $50,000. Incorporators, F. C. Mueller, B. Barragan, F. Dickinson.

Fearon-Tillotson Foundry Company, Chicago, Ill. Foundry and machine shop. Capital, $10,000. Incorporators, J. E. Chisholm, I. L. Miller, F. T. Winslow.

International Voting Machine Company, Elgin, Ill. Manufacture machinery and appliances. Capital, $1,000,000. Incorporators, A. L. Hall, G. M. Peck, R. E. Petrie.

Van Etten Machine Company, Sidney, O. Manufacture paper folders and feeders, etc. Capital, $15,000. Incorporators, F. D. Van Etten, C. D. Van Etten, E. J. Wagner, etc.

General Confectioners Machine Company, New York. Manufacture confectionery machinery. Capital, $65,000. Incorporators, H. H. Stacy, C. K. Mackey, C. W. Millard.

Perfection Nut Lock Company, Telkamah, Neb. Manufacture nut locks, bolts, etc. Capital, $1,000,000. Incorporators, M. R. Hopewell, H. J. Van Nostrand, M. W. Hopewell, etc.

Godfrey Gas Engine Starter Company, Oberlin, Ohio. Manufacture gas-engine starters and other machinery. Capital, $75,000. Incorporators, A. D. Booth, H. E. Arnold, H. H. Avery, etc.

Peerless Fender Company, New York. Manufacture fenders, wheel guards, etc. Capital, $50,000. Incorporators, P. S. Saitta, Jas. W. Saitta, Brooklyn, N. Y.; George A. Baker, New York.

Wm. H. Seddon Plumbing and Heating Company, East Broad street, Columbus, Ohio. General plumbing business. Capital, $25,000. Incorporators, W. H. Seddon, H. E. Burns, O. Gibson, etc.

The B. C. R. Electric Company, Cleveland, Ohio. Manufacture and deal in electrical machinery, repair automobiles, etc. Incorporators, G. W. Cottrell, H. E. French, Julius W. Tyler, etc.

The A. E. Katz Company, New York. Manufacture, deal in and repair typewriters, etc. Capital, $10,000. Incorporators, E. J. Forhan, J. J. Harper, G. F. Martin, all of 154 Nassau street.

Perfect Process and Tool Company, Buffalo, N. Y. Manufacture and deal in all kinds of hardware, tools, specialties, etc. Capital, $100,000. Incorporators, W. H. Hodson, O. M. Hodson, E. D. Woods.

Smith & Sinclair Machine Company, Camden, N. J. Engineers, machinists, blacksmiths, brass finishers, etc. Capital, $20,000. Incorporators, W. E. B. Smith, Allan Sinclair, W. W. Robinson.

The Filtrine Manufacturing Company, Brooklyn, N. Y. Manufacture and deal in devices for filtering water, etc. Capital, $100,000. Incorporators, G. Kneuper, G. M. Kneuper, A. D. Kneuper.

Standard Railway Specialty Company, New York. Manufacture and deal in supplies and appliances for railways, etc. Capital, $50,000. Incorporators, John L. Thurston, Spencer J. Estey, Thos. H. Cleverley.

Moline, Bettendorf Bridge Company, Moline, Ill. Capital, $100,000. Incorporators, Wm. P. Bettendorf, J. W. Bettendorf, E. H. Van Pattero of Davenport, Wm. Butterworth, W. A. Meese, Moline.

Eastern Safe and Vault Company, New York. Manufacture and deal in safes, vaults, etc. Capital, $200,000. Incorporators, W. H. Phelps, East Orange, N. J.; W. H. Smith, Mark W. Norman, New York.

Light Machine Company, New York. Manufacture and deal in engines, boilers, tools, etc. Capital, $50,000. Incorporators, Sam

uel Erang, 716 Sixth street, S. Polster, 386 First avenue, New York, etc.

Kalish Electric Company, New York. Manufacture and deal in electric supplies. Capital, $20,000. Incorporators, Henry Daubert, 1480 Fifth avenue, Max Kalish, 511 East Seventy-eighth street, New York, etc.

Times Square Automobile Company, Newark, N. J. Manufacture and deal in automobiles, carriages, boats, etc. Capital, $125,000. Incorporators, L. Weingarten, 405 Hugh street, Newark; Louis Mansbach, 215 West Forty-eighth street, New York, etc.

Cook & Wilkinson Company, New York. Manufacture and deal in wagons, automobiles, bicycles, etc. Capital, $25,000. Incorporators, Wm. M. Blain, Brooklyn, N. Y.; Geo. E. Cook, Lyman M. Wilkinson, New York.

Hydro-Tele-Motor Company, New York. Manufacture and deal in power transmission machinery. Capital, $25,000. Incorporators, J. W. McKay, Brooklyn, N. Y.; H. F. Fisher, New York City; E. E. Cole, Hoboken, N. J.

BUSINESS ITEMS

The American Pulley Company, Philadelphia, Penn., has added a number of new sizes to its line of steel pulleys.

The Triumph Electric Company, of Cincinnati, will give an industrial display on April 30. The manufacturers of the city are to be invited to inspect their products and buildings.

The Falk Company, Milkwaukee, Wis., has acquired the American and Mexican rights to all patents owned and controlled by C. Wüst, Seebach, Zurich, Switzerland, covering his double-helical gears and gear-cutting machinery.

TRADE CATALOGS

The Cleveland Stone Company, Cleveland, Ohio. Catalog No. 10 describing grindstones. Illustrated, 56 pages, 7x10 inches, paper.

The L. & D. Company, 80 Broad street, Boston, Mass. Circular illustrating and describing "Pullet" belt shifter and countershaft.

Modern Systems Correspondence Schools, 6 Beacon street, Boston, Mass. Pamphlet entitled "What Others Say," containing testimonial letters.

Lodge & Shipley Machine Tool Company, Cincinnati, Ohio. Catalog No. 21, describing engine and turret lathes. Illustrated, 112 pages, 6x9 inches, paper.

Automatic Time Stamp Company, 160 North Congress street, Boston, Mass. Catalog describing automatic time stamp. Illustrated, 16 pages, 3½x6 inches, paper.

The Henry G. Thompson & Son Company, New Haven, Conn. Catalog No. 14, describing power saw machines, hack-saw blades, tool holders, etc. Illustrated, 52 pages, 4x7 inches, paper.

WANT ADVERTISEMENTS

Rate 25 cents per line for each insertion. About six words make a line. No advertisements abbreviated. Copy should be sent to reach us not later than Friday for ensuing week's issue. Answers addressed to our care will be forwarded. Applicants may specify names to which their replies are not to be forwarded, but replies will not be returned, if not forwarded, they will be destroyed without notice. No information given by us regarding any advertiser using box number. Original letters of recommendations or other papers of value should not be inclosed to unknown correspondents. Only bona-fide advertisements inserted under this heading. No advertising accepted from any agency, association or individual charging a fee for "registration," or a commission on wages of successful applicants for situations.

Miscellaneous Wants

Caliper catalog free. E.G. Smith, Columbia, Pa.

We buy or pay royalty for good patented machine or tool. Box 282, AMER. MACHINIST.

Light, fine machinery to order; models and electrical work specialty. E. O. Chase, Newark, N. J.

It pays to use multiple stops on your lathes; one firm bought eight. Address Box 391, AMERICAN MACHINIST.

Special machinery accurately built. Screw machine or turret lathe work solicited. Robert J. Emory & Co., Newark, N. J.

Light and medium weight machinery and duplicate parts built to order; tools, jigs, etc. MacCordy Mfg. Co., Amsterdam, N. Y.

Oilstone holder, described on page 661, mailed for 25c.; shop agents wanted. F. J. Badge, 286 Taaffe Place, Brooklyn, N. Y.

Patents. C. L. Parker, Patent Attorney, ex-examiner Patent Office, 990 G St., Washington, D. C. Write for Inventor's Handbook.

Machinists send 10c. for pocket booklet, tables and formula; pipe tap U. S. standard and V-threads; agents wanted. W. Elsworth, 352 Montgomery St., Jersey City, N. J.

Foundry with first-class machine shop and exceptional facilities desires to contract for manufacturing machines or devices of gray iron. Box 419, AMERICAN MACHINIST.

A well equipped machine shop within 30 miles from New York solicits orders for all kinds of machine work. Send inquiries: The Brunswick Refrigerating Co., New Brunswick, N. J.

Wanted—To manufacture small machines, or parts; punch press, screw machine, lathe, shaper and multiple drill spindle work quoted on at reasonable prices. Joseph Pollak, 215 Sydney St., Dorchester, Mass.

A large English firm of machine-tool importers having showrooms and offices in Great Britain, France, Italy and Japan, is wanting good agencies for machine tools of all kinds. Apply Box 189, AMERICAN MACHINIST.

Dies and press tools for sheet-metal formation designed and constructed in a modern shop, under personal supervision of the best die man in this country. For dies, presses and anything in sheet-metal formation write to Joseph V. Woodworth, Mgr. Harwood Mfg. Co., 42 South 8th Street, Brooklyn, N. Y.

Proposals for ordnance supplies. Watervliet Arsenal, Watervliet, N. Y., April 16, 1910: Sealed proposals, in triplicate, will be received until 1 p.m., May 16, 1910, for furnishing steel, hardware, forage, fuel, oils, etc., during year ending June 30, 1911. Information furnished on application. Lieut.-Col. W. W. Gibson, Commander.

Help Wanted

Classification indicates present address of advertiser, nothing else.

CANADA

Mechanical superintendent to take charge of large machine shop; apply, stating experience and salary expected. Box 400, AM. MA.

CONNECTICUT

Wanted—An A-1 Acme automatic screw machine man; one who can supervise, lay out and design his own tools, etc., and one who can get maximum production on high "quality work;" every condition the best; this opening is made by plant doubling its screw machine equipment, all new machines. Box 362, AMERICAN MACHINIST.

ILLINOIS

A concern in the Middle West, manufacturing automobile and motorcycle engines, requires an experienced foreman grinder; a man familiar with the Norton, Landis, Heald and Pratt & Whitney machines; state age, experience and wages expected. Box 430, AM. MA.

The board of education of Chicago require teachers in the following departments: (a) blacksmithing; (b) foundry; (c) machine shop; (d) woodworking; (e) electrical construction; (f) mechanical drawing; minimum requirements: The equivalent of a high school education and three years' work in his line; examinations, June 27-28, 1910. For blanks and further information, apply to the Department of Examinations, 829 Tribune Bldg., Chicago.

MASSACHUSETTS

First-class toolmaker; must be a hustler, used to jig work and short cuts. Box 433, AMERICAN MACHINIST.

Wanted—Two good mechanical draftsmen; location central Massachusetts; state experience and salary expected. Box 426, AM. MA.

Wanted—An A-1 salesman who can show results to represent a young growing concern manufacturing a high grade machine tool; also a representative for greater New York. Box 421, AMERICAN MACHINIST.

Wanted—Competent, experienced mechanical draftsman and designer on steam turbine and electrical work, for permanent position with large manufacturing concern in Massachusetts; State age, education, experience and salary expected by addressing A. H. B., Box 408, AM. M.

Wanted—Young men with mechanical ability; experienced machinists and toolmakers, automatic and hand turret machine operators, Cleveland automatic screw machine operator experienced on forming work, carpenter for general repair work, young man patternmaker's assistant; for day and night work, in uptodate factory with all conveniences in a beautiful suburb, six miles from Boston; night gang Monday to Friday, inclusive. Boston Gear Works, Norfolk Downs, Mass.

MICHIGAN

Wanted—Toolmakers, die sinkers, lathe hands, machinists and automatic screw machine operators; A-1 men only. Buick Motor Co., Flint, Mich.

Wanted—First-class machine shop foremen; must be accurate and producers. Address Seager Engine Works, Lansing, Mich.

Wanted—First-class machinist capable of taking charge of a small shop turning out interchangeable parts; will require a man of good personality and executive ability. Box 432, AMERICAN MACHINIST.

Wanted—Machinists in Detroit; good machine and floor hands for medium and heavy work; good steady job with responsible concern to good men; state experience and references. Address Box 582, Detroit, Michigan.

Wanted—An experienced, energetic man, with a practical knowledge of general engineering and construction work, to act as assistant superintendent of maintenance, plant and equipment. Address, stating qualifications and experience, General Superintendent, Packard Motor Car Co., Detroit, Mich.

Wanted—One of the oldest and best established companies in the Middle West seek the services of a general foreman for their machine shop; about 350 are employed in the department, and building and equipment are thoroughly modern; the nature of the work varies from a line similar to automobiles and manufactured in large quantities, to a medium heavy plain class of railway equipment; none but high grade men apply, as the position is an important one and requires a man of broad experience. Box 415, AM. MACH.

NEW JERSEY

Tool designers wanted for jig work in an electrical shop. Address Box 431, AM. MA.

Toolmakers wanted, conversant with subpress die work for small duplicate parts; factory located in Newark, N. J.; men who have worked on watch dies preferred. Box 385, AMERICAN MACHINIST.

Wanted—Six (6) toolmakers; none but first-class applications will be considered; men that cannot fill the requirements herein stated are not wanted. Apply at the works of Henry R. Worthington, Harrison, N. J.

Wanted—By a large manufacturing concern, uptodate foreman with experience and executive ability; first-class opening for right man; state age, experience and salary expected. Box 413, AMERICAN MACHINIST.

Wanted—Machinists; steady work for good milling, boring, lathe and floor hands; also tool and die makers; call in person if possible; cheap rents and pleasant surroundings. Ferracute Machine Company, Bridgeton, N. J. (40 miles south of Philadelphia).

NEW YORK

Hands for automatic screw machine; state experience and wages desired. Box 435, AM. M.

Wanted—Skilled draftsman or mechanical engineer who can design an efficient automobile motor and do it rapidly. Box 424, AM. M.

First-class experienced drop forgers; steady employment, desirable surroundings. Write with references, Box 436, AMER. MACHINIST.

Wanted—First-class machinist to run Acme automatic screw machines; state experience in full and give references. Box 409, AM. MA.

Wanted—Several first-class jig and fixture draftsmen. Apply by letter or personal call to Merganthaler Linotype Company, 24 Ryerson St., Brooklyn, N. Y.

Wanted—Foreman for lathe department on auto transmissions; also lathe hands, Jones & Lamson and Gisholt operators; right wages for first-class men; no labor troubles. Box 416, AMERICAN MACHINIST.

Wanted—First-class toolmakers for punch, die and jig work; steady employment and good wages to the right men; state experi-

ence, age and wages expected. Salisbury Wheel and Mfg. Co., Jamestown, N. Y.

Wanted—A-1 machinists, familiar with small accurate machine work on lathes, planers and shapers; good wages and steady work to the right men; 55 hours a week. S. S. White Dental Mfg. Co., Prince's Bay, S. I.

First class head draftsman and designer in a steam pump works wanted; must have good references as to character and ability; state age, previous experience and salary expected. Answer by letter only. Box 448, AM. MACH.

Wanted—A machinist and first-class handy all-around man for repair work in a cereal mill to do repair work of all kinds and some work in machine shop; wages $3 per day, time and a half for overtime and Sunday work; steady work the year around. Box 411, AM. M.

Sales Representative—Company building high grade large and medium gas engine units, solicits correspondence with commission power machinery representatives in cities of New York, Philadelphia and Chicago; with the right parties will be considered liberal exclusive territory proposition. Box 429, AM. M.

Experimental engineer wanted by large manufacturing concern having technical and practical knowledge of mechanics and preferably chemistry as well; must possess special aptitude for this character of work. Address in confidence with full particulars, including salary expected. Business Service Co., 305 Broadway, New York.

Wanted—Assistant foreman for a hand screw machine department on a line of first-class automobile work; we want a man who can produce work rapidly and accurately and who understands piece work. When replying, state where employed for the past five years, in what capacity and wages desired. "Accurate," AMERICAN MACHINIST.

Wanted—Tinning department foreman by a large manufacturing concern having such a department, in which a variety of shapes are tinned, both drawn and pieced from black stock; applicants must have had experience as foremen in such work. Address in confidence, stating qualifications and wages expected, Walter H. Foster Co., 50 Church St., New York.

Wanted—We are constantly increasing our force and invite applications from the following: Machinists, lathe hands, screw machine hands, grinder hands, milling machine hands, motor assemblers, toolmakers, sheet metal die men; we run a nine-hour shop, have desirable surroundings, and offer steady position to desirable characters. Address Superintendent, Maxwell-Briscoe Motor Co., Tarrytown, N. Y.

Wanted — Practical draftsman, engines, pumps, general machinery, special tools for shop use, estimating, making up bills materials, requisitions, inspection, etc.; a capable man that has worked his way up through the shops, but well posted in theory and best practice preferred; state experience; give reference, present employer and salary desired, age. Apply to Edgar Penney, V. P., Newburgh, N. Y.

OHIO

Wanted—One expert tool and jig maker. Box 438, AMERICAN MACHINIST.

Competent lathe and vise hands by the American Tool Works Co., Cincinnati, O.

Wanted—Draftsman, familiar with detail crane design; state wages desired. The Toledo-Massillon Bridge Co., Toledo, O.

Wanted—First-class lathe, boring mill, shaper and planer hands; inquire at once. The Heisler Company, St. Marys, Ohio.

Wanted—A hustling general superintendent for a small electrical plant manufacturing electric vacuum cleaners; a good salary and an excellent opportunity for advancement is offered to a competent, general superintendent; must be a hustler, able to get work through the shop and a good organizer. Applications will only be considered from competent, experienced man. Address "Cleaner," Box 410, AMERICAN MACHINIST.

Wanted—First-class machinists, toolmakers die sinkers, lathe, planer, drill press, screw machine, boring and milling machine operators, wood patternmakers, brass molders, polishers, buffers, finishers, spinners, millwrights, hammermen and blacksmiths who are seeking positions or desirous of improving on those which they have, to register their names and addresses with the free Employment Department of the National Metal Trades Association. Address Commissioner's Office, 605 New England Bldg., Cleveland, O.

PENNSYLVANIA

Wanted—Die sinkers for hot forging; steady work; good pay. Apply Fayette R. Plumb, Inc., Bridesburg, Philadelphia.

Specification clerk wanted; must be a first-class draftsman, and thoroughly familiar with shop work. Apply at Chadwick Engineering Works, Pottstown, Pa.

Wanted—Die setters die makers, jig and fixture makers and wood pattern makers. Apply at Employment Department, Westinghouse Electric & Mfg. Co., East Pittsburg, Pa.

Wanted—Inside wiremen, tinsmiths, coppersmiths, sheet metal workers, Schwartz and crucible furnace hands and punch press hands. Apply at the Employment Department, Westinghouse Electric & Mfg. Co., East Pittsburg, Penn.

Wanted—Plain, slab and portable milling machine hands, horizontal and vertical boring mill hands, automatic screw machine hands, shaper hands, universal tool and shaft grinders. Apply at the Employment Department, Westinghouse Electric & Mfg. Co., East Pittsburg, Penn.

Wanted—We have positions to offer from time to time for the following lists of first-class mechanics: Metal pattern makers; wood pattern makers; iron molders, bench; iron molders, floor; brass molders, bench; machinists; brass finishers, Fox monitor; brass finishers, turret lathe; toolmakers; work consists of brass and iron valves and fittings. In applying for any of the above positions state age, experience and wages. Address F. E. Johnson, Supt., The Kelly & Jones Co., Greensburg, Pa.

WISCONSIN

Toolmaker, first class, one with executive ability, with view of advancing to foremanship. Answer, stating age, nationality and full experience; good opening for right man. Box 381, AMERICAN MACHINIST.

Wanted—Tool designer, capable of designing tools, jigs, etc., for the economical production of work; gas engines and other machinery; Middle West. Address with full particulars, Box 402, AMERICAN MACHINIST.

Situations Wanted

Classification indicates present address of advertiser, nothing else.

CONNECTICUT

Position as superintendent or factory manager; 20 years' experience, 12 years as executive; experienced in the production of high grade interchangeable work. Box 444, AM. M.

Foreman manufacturing sheet metal novelties, milling machine and turret lathe products, desires position; an all-around toolmaker; technical education; fitted for assistant superintendent. Box 447, AMER. MACH.

ILLINOIS

A successful superintendent of the Otis Elevator Company is seeking change of position. Address Box 230, AMER. MACHINIST.

Position as expert assistant to general manager; specialties, organization, purchase and layout of tools, increasing production in machine shops, foundries and manufacturing plants; wide experience as superintendent; accustomed to large works. Box 422, AM. M.

INDIANA

Situation wanted by a foreman, successful in increasing production and reducing cost of manufacturing; executive ability; expert jig designer; now holding similar position, manufacturing gas and stationary engines, motor and transmission, but desires change. Box 420, AMERICAN MACHINIST.

Mechanic, 36 years old, with 10 years' experience as foreman and superintendent, in sheet metal manufacturing; good systematizer, and uptodate in modern methods of manufacture, desires a change by the first of June; Chicago or immediate vicinity preferred. Box 434, AMERICAN MACHINIST.

MASSACHUSETTS

Position wanted by first-class designer; experience, general, and automatic machinery; state particulars. Box 442, AMER. MACH.

Practical man, experienced in shop, in office as draftsman and cost accountant, with good references as to ability and character, invites correspondence with parties relative to some responsible position with good future. Box 441, AMERICAN MACHINIST.

Wanted—A situation as mechanical superintendent or works manager; I have executive ability and practical mechanical experience that will meet the most exacting requirements in all departments for the manufacture of any class of mechanical goods and machinery. Address Box 439, AMER. MACH.

NEW JERSEY

Experienced machinery salesman, wants position, any good line; open end of present month; moderate salary to start, practical and technical training. Box 440, AM. MA.

Superintendent and factory manager; high class, hustling and efficient executive, expert on tools, gages, dies, fixtures, machine building; thoroughly understand handling help and dealing with the human element in manufacturing, speed and production my specialty; never failed to surpass all expectations. Address "Mechanical Engineer," Box 428, AM. M.

NEW YORK

Mechanical engineer, 27, technical graduate; eight years' practical shop and drafting experience on mill machinery; marine and general engineering; at present engaged. Box 445, AMERICAN MACHINIST.

Situation wanted by a mechanical draftsman; experience on Corliss engines, air compressors, pneumatic machinery and gasolene engines; references A-1. Box 417, AM. MA.

Experienced foreman, middle aged, latest ideas, now employed, engineering work, dynamos and general machinery; A-1 hustler; can handle large force with ability. Box 427, AMERICAN MACHINIST.

First-class mechanic, well up in modern tool room and machine shop practice, 22 years' experience, wishes position as tool room or general machine shop foreman; can furnish good reference; location immaterial. Box 443, AMERICAN MACHINIST.

Position as superintendent; now employed in similar position handling 250 hands; A-1 mechanic; wide experience in manufacturing small or medium interchangeable parts; first-class organizer and executive; can produce results. Box 446, AMERICAN MACHINIST.

Mechanical engineer and first-class draftsman desires change; familiar with general plans and outlays for factories, automatic and conveying machinery; four years' practice in one of the largest concerns in New York; position wanted in or near New York City. Box 425, AMERICAN MACHINIST.

PENNSYLVANIA

Experienced superintendent open for engagement; large experience in designing and building tools and dies for close, interchangeable parts at the lowest cost; I can get you the results in your shop; best of references. Box 418, AMERICAN MACHINIST.

RHODE ISLAND

A good executive and tool designer now bringing out a heavy sewing machine in southern Ohio desires change; promises of superintendence with contracts such as to avoid living up to if not considered; responsible parties only need answer. Address O. W. Plant, Care of Z Lambert, 835 Atwells Ave., Providence, R. I.

FOR SALE

For Sale—3"x7" Corliss engine, hook motion. Address Care 2802 Jane St., S. S., Pittsburg, Penn.

For Sale—One No. 10 Baush 16-spindle drill press, for ½" drills, in first-class condition. Box 437, AMERICAN MACHINIST.

For Sale—One-half interest in a fully equipped machine shop with garage attached, in Newport, R. I. Address P. O. Box 264.

For Sale—One variable cut-off Atlas engine, 50 h.p.; one 4 ft. by 12 ft. boiler; both in good condition and can be seen in operation. L. F. Fales, Walpole, Mass.

For Sale—A complete Davis-Bournonville oxy-acetylene apparatus in first-class order; has been used about one year; can be seen at the Hartford Suspension Co., 150 Bay St., Jersey City, N. J.

For Sale—One Fifield lathe 22" swing, 24' bed with compound rest, four step cone pulley, back geared, screw cutting, face plate chuck, steady rest and feed gears, all in good condition, $225. Baker Brothers, Toledo, O.

For Sale—Blue print car outfit; frame 30x42 with pad, and car made to revolve and tilt at any angle to get direct rays of sun; made by the American Drafting Furniture Co., Rochester; condition first class; reason for selling, no further use for it. Box 414, AM. M.

For Sale—One Nash gas engine, 20 horsepower, two cylinder, for electric lighting, pumping or power; one Beaman & Smith horizontal boring mill; table 25 inches wide, 36 inches long; will bore 12 inches diameter, 24 inches long, and face 20 inches diameter; one 300 light J. B. Colt Co. acetylene gas apparatus. The above machines are in excellent condition, having been very little used. For further particulars and prices apply to Rider-Ericsson Engine Co., 35 Warren St., New York.

Stock for Sale—Controlling interest in the Fishkill Landing Machine Company, builders of the "Fishkill Corliss" engine, machinery, castings, etc. Business long established, having an enviable reputation for the high character of its work. The works are located on the east bank of the Hudson river, fifty-eight miles above New York City, and about three minutes' walk north from the Fishkill Landing station of the New York Central Railroad, a track of which runs through the works. Having several other railroad connections, in addition to their extensive dock frontage, afford unsurpassed facilities for receiving and shipping by rail or water. This is one of the finest properties in New York State, and as a large part of it is not required for the present business, it is very valuable for any manufacturing purpose. For particulars, address W. F. Sage, Fishkill-on-Hudson, N. Y.

A Systematic Solution of the Belting Problem

A Method in Place of Guess Work and the Way it Works

By Wm. H. Taylor

Many experiments on the transmission of power by belting have been conducted by Wilfred Lewis, F. W. Taylor, Prof. W. W. Bird, Carl G. Barth, Prof. Wm. S. Aldrich and others, to determine under actual working conditions, the internal resistance to be overcome, the percentage of slip, the coefficient of friction on belt surface, the elastic property, the relation between tension and stretch, and the stretch due to this tension, belt creep, etc., etc., from which many empirical mathematical formulas have been developed to represent the facts established by the experiments.

The theoretical, mathematical and mechanical questions involved in the transmission of power by belting may be of interest to the engineer and student, but the commercial facts are those which most interest the manager and superintendent. It remained for F. W. Taylor, in the work of investigation, to include both mechanical and commercial factors, his problem being: How wide a belt must be used so that a given horsepower may be transmitted with minimum cost for belt repairs, the longest life to the belt and the smallest loss and inconvenience from stopping the machine while the belt is being tightened or repaired? The result of his conclusions is, that the most potent factor in determining the life of belting and its cost for maintenance and repairs is the *total load* to which it is subjected, or the *pull per square inch of cross section.*

Actual experience sustains the following assertions: To obtain the highest economy in belting it is necessary to limit the *initial tension* and the *total load* to a point below that fixed by former rules. The importance of adopting means for determining and limiting the tension of belting is not fully realized by users of belting in general. Facts based on careful observations covering a term of years, show that the life of belting is materially increased when the proper tension is defined, with reference to width, length and thickness, by mechanical means; and as a consequence, the cost of maintenance and repairs under this rule have been reduced to 14 per cent. per annum as against 37 per cent. of the cost of belts tightened in the ordinary manner.

By "the ordinary manner" I mean the customary millwright's practice, by which belts are made wide enough and tightened to drive machines at the maximum power expected or guessed to be required at any time, with no reference to economy of belt transmission, which depends principally upon the journal friction and slip. When a belt is too tight there is a constant waste in journal friction, and when too loose, there may be a much greater loss in efficiency from slip.

Belt clamps having spring balances between the two pairs of clamps were designed and employed by Mr. Taylor in 1885, at the works of the Midvale Steel Company, for weighing the tensions of all belts each time they were tightened. He formulated rules, derived from lengthened actual trials, governing the tensions put upon belts when laced or joined and which were made known in his paper "Notes on Belting" read before the American Society of Mechanical Engineers in 1903.

Subsequent modification and extension of Mr. Taylor's ideas were made by Carl G. Barth, who compiled empirical mathematical formulas representing the established facts, constructed diagrams which graphically solved problems dealing with contained variables, and finally constructed a slide rule for more convenient solution of belting problems solved by the diagrams. In fact, Mr. Barth's slide rule facilitates the solution of belting problems in the most approved manner.

When the tension scales were first employed, the scales were put directly on a belt in its position over the pulleys, after which the belt was separated, tension weighed and the belt respliced under the required tension. While this method was highly efficient in the results obtained, it proved inconvenient and consumed time owing to the location and number of belts, and in 1900 Gullow Gulowsen conceived an indirect method of securing the desired tension in a belt.

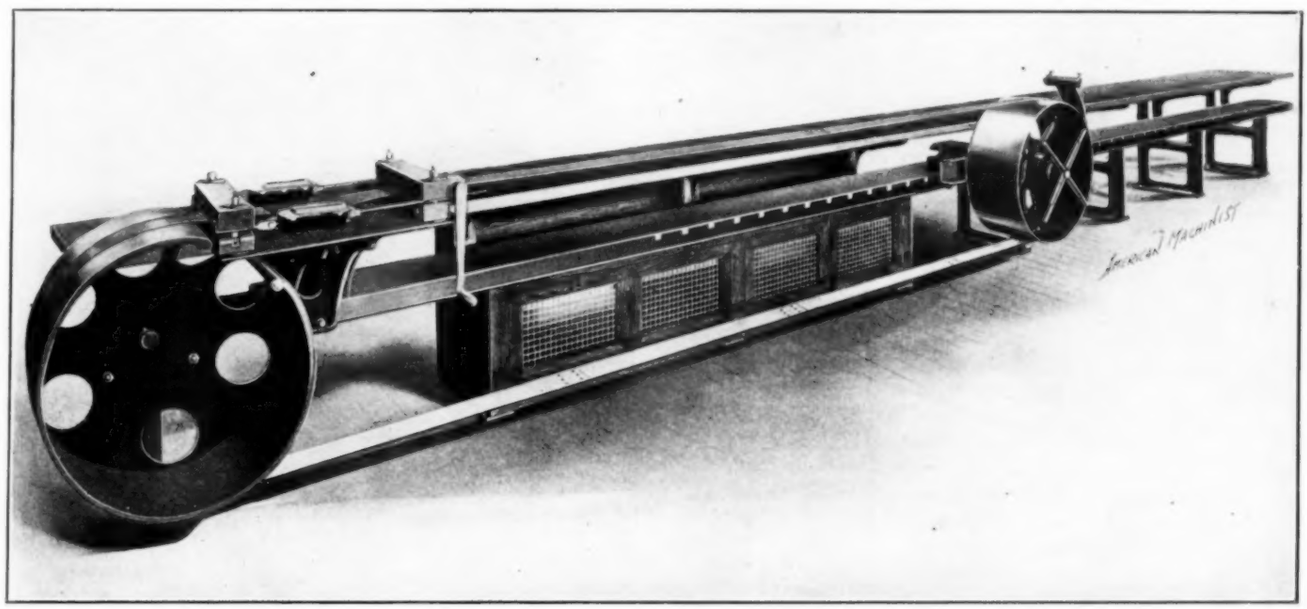


FIG. 1. IMPROVED BELT BENCH ARRANGED TO DETERMINE THE LENGTH AND WEIGH THE TENSION IN A LONG BELT

He also made drawings from which the first belt bench and the first improved belt scale were made at the works of the Bethlehem Steel Company. This bench was provided with a pair of pulleys which could be so adjusted that a tape line would measure the same around these pulleys as over the pulleys on which the belt is to run. A belt cut and laced to give a prescribed tension when the bench pulleys have been properly adjusted, will be the same length to assume the same tension over its own pulleys.

Subsequently benches and methods for the care and maintenance of belting (the latter was devised by Messrs Taylor and Barth) were installed in the works of the Link Belt Company, Nicetown, Philadelphia, Penn., Yale & Towne Manufacturing Company, Stamford, Conn., and the Tabor Manufacturing Company, Philadelphia, Penn. In 1908 it occurred to Wilfred Lewis and the writer that with a few modifications and improvements the belt bench could be converted into a machine that would facilitate the handling of belting in a more approved manner and with a greater degree of accuracy that could be accomplished with a wooden bench. These conceptions were developed and resulted in placing on the market the belt bench illustrated in Fig. 1 and described hereinafter.

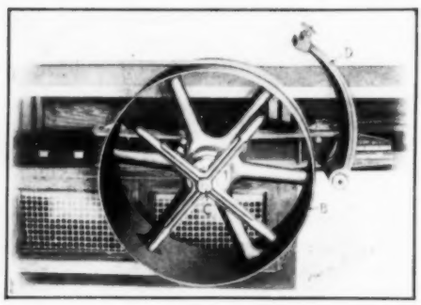


FIG. 2. ARRANGEMENT OF BELT BENCH CARRIAGE WHEN APPLYING TENSION TO LONG BELTS

DESCRIPTION OF THE BELT BENCH

The improved belt bench consists of a 12-inch channel 32 feet long, supported on eight cast-iron stands, one end of which supports a drum-like casting fixed permanently thereto. This drum forms a receptacle for a roll of belting and also acts as the equivalent of a pulley around which to lay a belt. The drum's flange is so constructed as to form a gap into which the face plate of the bracket, which supports the tension scales, projects, and through which a belt may pass before it has been cut off the roll. The channel acts as a rail along which a carriage, supporting a revolving drum, travels. The channel rail is graduated on its top for measuring belts under 16 feet in length, and on its front side for measuring belts from 16 to 60 feet in length.

The carriage, as shown in Fig. 2, consists of a triangular-shaped frame, whose base parallels the channel rail longitudinally, and is supported at three points on rollers. Two rollers (*A A* in Fig. 2) act as supports, located to travel in a line along the top of the channel rail near the front edge and to act as fulcrums so that the overhanging weight in front of the carriage will keep a third roller, located under the apex of the frame, up in contact with the edge of the channel's rear flange. The alinement of the carriage with the channel is effected by means of guides projecting downward from the frame, front and back, so as to face the channel rail flanges with clearance between them. From the apex to the base of the carriage frame runs a hollow arbor, projecting on the front side sufficiently to support a revolving drum (*B* in Fig. 2). Through the center of the arbor runs a screw to which, on the end projecting front, is attached a clamping spider (*C* in Fig. 2), and to the back end is attached a cast-iron jaw. When the screw is drawn up the channel rail is gripped by the guides on the front of the carriage frame and by the jaw in the rear and held sufficiently rigid to withstand any strain imposed when weighing tensions.

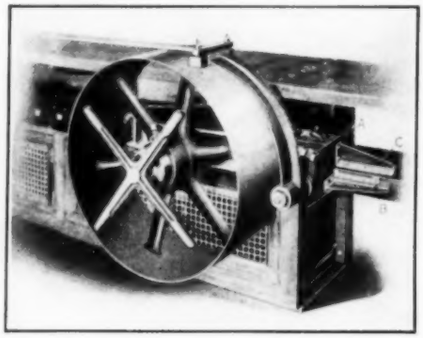


FIG. 3. ARRANGEMENT OF BELT BENCH CARRIAGE WHEN APPLYING TENSION TO SHORT BELTS

To the right of Fig. 2, and marked *D* is shown an arm with clamp attached; in this instance it is locked back out of the way when applying tension to long belts. The arm is pivoted on a stud projecting from the carriage frame and is held in position away from the drum by means of a forked stop (*A* in Fig. 3).

When changing positions, as shown in Figs. 2 and 3, the arm is provided with an outward movement so that it may clear the forks in the stop and can be moved to a central position resting against the drum, this is accomplished by means of a compression spring fitted into the hub of the arm and kept under tension by means of a washer bolted to the end of stud.

The scales shown attached to the carriage in Fig 1 and marked *B* for long belts and *C* for short belts, are employed for setting the carriage, so that when a belt is passed around the drums or is clamped to the arm, it will be the desired length. The scales are graduated to indicate the fractional parts of the graduations on the top and side of the channel rail.

The face plate of the tension scale bracket is provided with two sets of holes into one set, dowel pins attached to angle stop (*A* in Fig. 4) fit, and into the other dowel pins of marking block (*B* in Fig. 4). The former are used to support the stationary clamps of the tension scales when weighing the tension of short belts, the latter for defining the belt's length at the edge marked *X* in Fig. 4.

The belt bench is provided with a hardwood top over its entire length, to be used for laying out and repairing belts, and with two closets for storing belts.

TENSION SCALES

The tension scales consist of two pairs of clamps connected by screws that act through a pair of spring balances. One pair of clamps are stationary, to which the spring balances are attached, the other pair are attached to the screws which in turn are connected with the spring balances and are moved toward or away from the pair of stationary clamps by nuts rotated by a cross shaft which in turn is actuated by a hand crank. The clamps are drawn together by means of bolts and nuts located at each end of the clamps. The crank used to wind up the scales fits the nuts on the clamps. Each pair of clamps is provided with a hinge, staple and pin, so that the clamps can be opened up for cleaning. The scales have a capacity of 500 pounds each, consequently are capable of weighing tensions up to 1000 pounds.

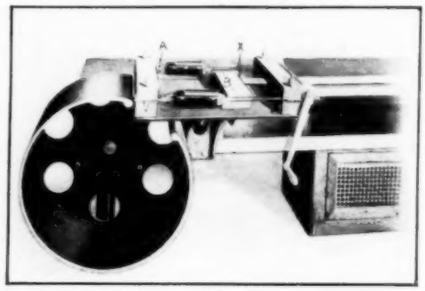


FIG. 4. ARRANGEMENT OF TENSION SCALES ON BELT BENCH

DIRECTIONS FOR USING

When an old belt is to be tightened, respliced or repaired, or a new belt is to be fitted over a pair of pulleys, the length and tension are noted on an order to the belt fixer, which will be described herein-

after as part of a system for the care and maintenance of belting.

If the belt is over 16 feet in length the carriage is moved to the desired dimension, indicated in feet by the graduations on the side of the channel rail and further adjusted to the fractional parts thereof by reading from the scale marked "long belts." The tension scales are placed in position on the face plate of the bracket near the fixed drum, with both pairs of clamps loosened. If the belt to be retightened is an old one, one end is passed through the clamps nearest the fixed drum, so that it projects to about the center distance between the two pairs of clamps and the nuts on either side of the clamps are drawn down uniformly until the belt is firmly clamped. Care must be exercised to square the end of the belt and locate it central in the clamps. This is accomplished by means of a graduated scale attached to the upper jaw of the clamps. The remaining portion of the belt is passed around the two drums and the loose end brought back and passed through the remaining pair of clamps and tightly clamped. In laying the belt over the drums care must be taken to locate the belt in a central position on the drums. A series of parallel lines which act as guides, are scribed on the face of each drum for the purpose.

In case the belt is a new one, the roll of belting is placed in the open drum and the loose end is passed through the gap under the clamps nearest and between the clamps farthest away, over to and around the revolving drum, back to and around the stationary drum, between the clamps, carrying the end of the belt halfway between the two pairs of clamps. After squaring the end and seeing that the belt lies in a central position over the drums and in the clamps, the clamps are tightened by drawing up the nuts alternately so that the pressure is evenly distributed over the entire width of belt.

The tension scales are ready to be "wound up." By means of a crank the clamps are drawn together until the spring balances record the tension desired. During the process of "winding up" the belt should be agitated by slapping the two strands midway between the drums to equalize the tension on both. The overlapping end is now cut off so that the two ends meet within ¼ of an inch. This allowance is made for stretch in that portion of the belt lying between the clamps. Care must be exercised to cut off the excess absolutely square. The belt is now removed and laced on a belt-lacing machine ready to be placed in position over its pulleys.

Machine lacing, when spiral lacing is employed, affords greater convenience and consumes the least time in installing and removing plates for the purpose of repairing and tightening on the belt bench.

Directions for Wire Lacing a Belt

After the desired length has been marked on the belt, it is removed to a belt-lacing machine where it is inserted (beginning at the front of the machine) between a pair of jaws until the line marking the belt's length is flush with the upper jaw, when it is clamped by lowering a lever (*A* in Fig. 5), which actuates the jaw. The excess is then cut off by pulling out the handle (*B* in Fig. 5), attached to a cutting device, shown in Fig. 5. The clamping lever is then raised and the belt removed. The head is then raised into position against the jaws and the hand crank (*C* in Fig. 6) located in front of the head is actuated until the finger or the index plate indicates that the guides are set for lacing a single or double belt, as the case may be. The belt is reinserted between the jaws (beginning from the back of the machine) and shoved forward until it butts against the guides, when it is clamped by lowering lever *A*. A spiral needle is inserted in hole (*E* in Fig. 9) at the right of the head until it is gripped by the screws, then by rotating the crank (*D* in Fig. 6) the needle traverses the entire width of belt piercing a series of holes spaced to conform with the lead of the screws and pitch of the wire lacing. As soon as the needle has traversed and is clear of the belt, a coil of wire lacing is inserted into the hole (*E* in Fig. 6) and the crank rotated, thus inserting the wire lacing in the holes pierced by the needle until the end of the coil is flush with the edge of the belt as shown in Fig. 7. Then the coil is cut off so that it leaves both ends flush with both edges of the belt. The head is released and swung back, the clamping lever raised and the belt drawn back until the wire lacing rests on the corrugated plates in the jaws, when it is flattened by lowering the jaw with the lever. The belt is now withdrawn from the machine and the loose ends of the wire lacing are bent back and forced into the leather. This is imperative that injury to the workman's hands may be avoided when shifting belts. Rawhide pins should be used for joining the two ends of a belt, and cut so that the ends of the pin will not project from the wire lacing beyond the edges of the belt, but should be about one-eighth of an inch short on either side.

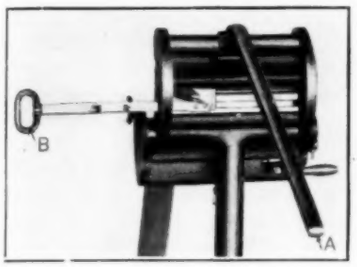


Fig. 5

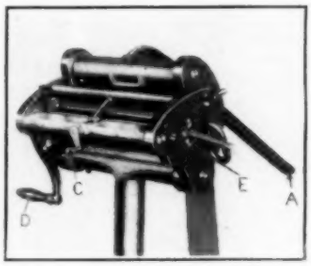


Fig. 6

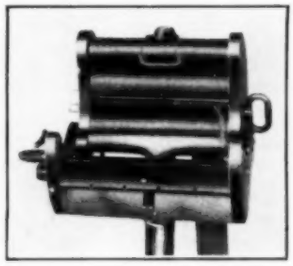


Fig. 7

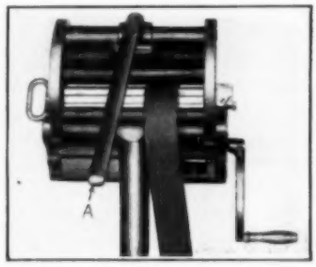


Fig. 8

Operations of Wire Lacing Machine

Only one wire joint should be employed in joining the ends of any belt, for when any other section of a belt becomes damaged as to necessitate the insertion of a new piece, cement splices should be made.

When a belt needs retightening, and before the belt is cut, the wire lacing at each end should be examined to determine whether the wire is worn or has cut through the leather. In case only one end shows wear the excess amount to be removed may be cut off the worn end; in case both ends show wear, half of the excess amount to be removed should be cut off from each end.

Systematic Care of Belting

When adopting a system for the care and maintenance of belting, the first essential step is to ascertain the following information pertaining to each belt in the works:

a Location of belt.
b Its purpose, machine, etc. } cone, countershaft.
c Exact length over its pulleys, measured with a steel tape.
d Width.
e Thickness in inches.
f Maximum velocity.
g Minimum velocity.

These data, together with the maximum and minimum tensions under which the belt is to run (which is acquired from Barth's belting slide rule) is posted on a "belting-record" form, illustrated in Fig. 9. For the purpose of identification it

is well to designate all belts by either symbols or numbers.

After the necessary information appertaining to each belt has been posted on the belting records, the next step is to set dates for overhauling each belt throughout the year. This is best accomplished by using the following empirical compilation: New belts usually require tightening, then after 24 hours' service, two days' service, four days' service, eight days' service, 16 days' service, one month's service, two months' service, from two to six months, depending upon the service required of the belt.

will be apparent, as will be the cost of maintenance for each belt, from which inferior belting can be immediately detected by basing the cost of maintenance and repairs at a figure not to exceed, on an average, 14 per cent. per annum of the belt's initial cost.

When the foregoing data have been recorded for all belts in the works, and a belt bench and appurtenances installed, orders to the belt fixer for repairing or tightening each belt should be made out from the data recorded on the belting records on a ticket, illustrated in Fig. 10.

To secure freedom from interruption to

DM. 20

DEPARTMENT DM — BELT SYMBOL 2 L C

BELTING.

1st Floor (Wing B)

LOCATION Drive from 1T to 2L line shaft — LENGTH OVER PULLEYS 62'-4½"
PURPOSE Mule Belt 90 and crossed — WIDTH 6"
KIND Double Belt — THICKNESS 3/16"
MAKER'S NAME Alexander Bros. — CROSS SECTION IN SQ. IN. 2.25
DATE PUT IN USE March 18, 1908 — HOW FASTENED Wire Lacing
DATE TAKEN OUT — BELT GREASE TO BE USED Pluma
LIFE OF BELT — BELT DRESSING TO BE USED

MAX. VELOCITY 2100'
MIN. VELOCITY
MAX. TENSION 240 lbs. } ON EACH SPRING BALANCE
MIN. TENSION 140 "
COST OF BELT $60.61
COST OF MAINTENANCE
TOTAL COST

This belt to be tightened on Saturday only

DATE RE-TIGHTENED	TENSION IN LBS. INDICATED BY EACH SPRING BALANCE: BEFORE TIGHTENING	TENSION IN LBS. INDICATED BY EACH SPRING BALANCE: AFTER TIGHTENING	AMOUNT TAKEN OUT	DATE TENSION AGAIN SHOULD BE TAKEN	DATE CLEANED AND GREASED	DATE TO BE CLEANED AND GREASED AGAIN	DATE DRESSING PUT ON DURING SERVICE	GENERAL REMARKS ABOUT WORK DONE ON BELT, CONDITION OF BELT, ETC.	WORKMAN'S NAME	MAN'S TIME REQUIRED TO DO WORK	COST OF WORK
3-15-08		240	New	3-20-08					Kepner	5 hrs	1 30
3-20-08	70	240	5"	3-24-08					Kepner	1 hr	30
3-24-08	90	240	3/4"	3-28-08					Kepner	1 hr 12 m	24
3-28-08	120	240	3/8"	4-6-08					Blackwell	1 hr 18 m	23
4-6-08	140	240	2"	4-20-08					Kepner	1 hr 12 m	24
4-20-08	100	240	2 1/4"	5-1-08					Kepner	48 m	16
5-1-08	110	240	2 1/4"	7-29-08					Kepner	1 hr	21
7-29-08	120	240	2 1/4"	10-1-08					Kepner	54 m	18
10-1-08	110	240	3"	12-4-08					Kepner	1 hr	32
					10-1-08	11-4-08			Kepner	1 hr 18 m	32
									Kepner	1 hr 18 m	34
									SKI	12 m	04
12-4-08	120	240	2"	12-11-08					SKI Kepner	1 hr 1 hr	26
					1-9-09	3-11-09			SKI	18 m	06
3-11-09	110	240	2 1/4"	4-10-09					Kepner	1 hr 6 m	22
3-11-09	140	240	1½"	4-12-09				Belt slipped	Kepner	1 hr 12 m	24
					3-11-09	5-12-09		Repairs	Kepner	1 hr	36
4-12-09	120	240	1 3/8"	6-15-09					Kepner Travis	1 hr 1 hr	30
					5-12-09	8-12-09			Travis	30 m	15
								Carried forward to Sheet #2			37 43

American Machinist

FIG. 9. SPECIMEN BELTING RECORD

Belts not run under severe conditions need not be tightened oftener than once in three to six months, but this can only be determined by observation of the time it takes each individual belt to stretch so that the tension falls to the minimum. At the start each belt should be taken off its pulleys, the tension tested and tightened if necessary, once every two months for cone belts; once every three months for countershaft belts, and the period extended in either instance if the tension is found sufficiently above the minimum not to require tightening. Further than intelligent judgment, no fixed rule can be employed owing to the different conditions under which belts of the same size work.

The belting record sheets should be periodically inspected by the works engineer or superintendent and any irregularities checked so as to insure the system being advantageously followed out. On examination, any irregularities manufacture, belts should be tightened and repaired outside of working hours. In starting the system the number of belts to be repaired or tightened daily should be divided, so that the belt fixer be given six belts per day, three during noon hour and three after closing. Belt fixer's tickets should, therefore, be divided into lots of six, each lot being dated for the date on which their respective belts are to be tightened. If on this basis it should require more than two months time for tightening and making minor repairs to all belts in the works, it will be necessary to increase the number of belts to be handled each day.

To facilitate regularity in assigning work for the belt fixer, a tickler should be provided; one containing a portfolio for each day in the year, as illustrated in Fig. 11. The clerk who attends the tickler distributes the belt fixer's tickets in the portfolios under the dates indicated thereon, and on each succeeding day in the year opens the portfolio of that date, and all memoranda of belts requiring attention on that date are sent to the belt fixer. The belt fixer indicates on the ticket the nature of the work done by him, the time consumed, the amount removed, and any remarks concerning future probable repairs, etc., returns it to the clerk in charge of the belting records, who in turn posts the information on the belt record corresponding to the belt that has been tightened or repaired. At the same time he fixes a future date on which the belt next needs attention and makes out a belt-fixer's ticket which he places in the tickler under that date.

The tickler will be found exceedingly useful for making all of the repairs in and about the establishment. By means of it, all machinery, buildings, and even boilers and drains, etc., may be inspected and overhauled before trouble is likely to occur with them. By its use interference to manufacture is anticipated, whereby many breakdowns can be averted. No one man, or even a combination of men, can carry in their heads the apparatus which should be inspected and repaired each day in this way, in order to carry on repairs cheaply.

SYSTEMATIC CARE OF BELTING

One of the most important elements in works management is the systematic care of belting. The careful observer will find in the majority of instances that the belting employed is too light for doing the most economical work and inferior methods of fastening and caring for belting are in common use; so that when an attempt is made to push a machine to its maximum capacity, it results generally in the belt slipping, breaking, or the lacing giving out.

To obtain the maximum production from belt-driven machines the belts must be in condition to transmit the power required. This can only be accomplished when the belts are systematically inspected, tightened, repaired, cleaned and greased at proper intervals by a man, or men, trained to perform these particular functions with regularity.

No dependence can be placed upon belting where its care is left to the machine operator, nor even where it is left to a belt fixer who is provided with no means, other than judgment, of determining how tight a belt is, or should be, and who tightens, repairs and cleans belts only when their condition becomes so bad that they are practically incapable of transmitting power.

Secondary in importance to belts being always in such condition that the maximum output is assured from the machines, is the cost of maintenance. Belts of good quality properly cared for, should last from five to ten years, depending upon the service they are required to perform; and when not properly cared for they rarely last more than

from two to three years. It is a fact that in the average shop very few belts become unfit for service through legitimate wear, but are usually ruined through accidents, improper care, or lack of care.

Causes of Destruction

A frequent cause of premature destruction of belts is that they are almost invariably made too wide for their pulleys, so that misalinement or crookedness in a belt will cause part of it to run beyond the face of its pulleys, and as a consequence rubs against any object in close proximity, such as shifting fingers, or a flange of an adjoining step of a cone pulley, etc. Poor shifting devices are also responsible for the destruction of a good many belts by allowing the belt to run partly on a loose pulley and partly on a fast one.

Where cone belts become loose from lack of systematic care, the machine operator often runs them on cross cones (i.e., on steps not in line with each other) for the purpose of making them tighter, or *vise versa* when too tight. This causes the edge of the belt to rub, curling it and separating the layers and laps, and to stretch on one side, any of which would ruin the belt very quickly.

Belts laced with rawhide lacing, unless done by an expert, will usually run crooked, owing to the ends not being cut square, or the lacing stretching on one side more than on the other.

Splices made by the manufacturer often separate, and if not attended to within a reasonable time will cause serious damage to the belt, whereas, if the belts are systematically inspected this is detected in time and repaired before the belt is injured.

The use of rosin or any resinous mixtures, labeled "belt dressing," on a belt will ruin it. Temporarily it causes adhesion, but after a short space of time it becomes glazed and loses its tractive force, causing the belt to slip to a greater degree than before it was applied. It is absorbed by the leather, thereby eliminating the natural lubricating properties, causing it to become dry and hard and renders the belt impervious to the effect of oil or grease employed to render it pliable. Under no circumstances should its use be permitted.

Remedies

Only the best quality of belting should be used. Double belts in most instances will prove most economical, when used on pulleys larger than 6 inches in diameter. All shifting devices, where necessary, should be altered so as to be well defined in their various positions and their shifting fingers separated somewhat further apart than the width of the pulleys. The pulleys should be wider than the belt and sufficiently crowned so that the belt will take its proper position on the pulley without being forced over by the shifting fingers. Every pair of cone pulleys should be alined so that the belt will run free of the step flanges, even if it should require a narrower belt. In answer to the objection that will be raised, that the belt will then be too narrow to transmit the power, it may be said that a narrow belt, in good condition, whose tension is never allowed to fall below a prescribed minimum, can be depended on to transmit more power than will a wider belt in poor condition and as slack as belts are usually allowed to run when not systematically cared for.

Fig. 10. Specimen Belt Fixer's Ticket

Greasing

Each belt in the works should be scraped clean once every six months, and a belt grease applied so as to render it pliable and to give the grain side a soft adherent surface. After a belt has been running for some time, the oil and grease, with which the leather was originally stuffed, becomes exhausted; due to the action of heat, friction and atmospheric conditions, and thus the fibers of the leather lose their lubricant, which necessitates a further application of grease to keep the fiber whole and render the belt pliable.

The only grease that should be used is the same as is employed by the makers; that is, edible beef tallow and cod-liver oil, mixed in accordance with the following recipe: 2 parts (in pounds) edible beef tallow, 1 part (in pounds) cod liver oil. Melt the beef tallow, then allow it to cool until one's finger can be inserted without burning, then add the cod liver oil and stir in one direction until cold.

Apply a light coat with a 1-inch wide camel's hair brush to the driving side of a belt. Never apply more than the belt will easily absorb.

The cleaning and greasing of belts should be cared for by orders placed in the tickler, a new order being made out each time a belt is cleaned and greased, dated six months ahead.

In case a belt slips during manufacturing hours it is permissible to use a liquid belt dressing, applied sparingly. This application will enable the belt to pull until it can be reported, and tightened after working hours.

Cleaning

Every precaution should be employed to prevent belts becoming saturated with lubricating oil from the shaft or machine bearings. In the case of oil-soaked belting it should be scraped clean and packed in sawdust from 48 hours to a week.

Splicing and Lacing

Joining the ends of a belt by cement splices, so as to render it endless, is undoubtedly the most mechanical method and will prove satisfactory under all conditions if means are provided for taking up the slack; but as this entails considerable expense and necessitates cementing the splices while the belt is in position over its pulleys, a mechanical method of lacing, one which facilitates the rapid handling of belts in installing, removing and in lacing, is recommended. One which gives very satisfactory results is obtained by having but one inferior joint in the belt, namely, the spiral wire lacing, joined with a rawhide pin. There are several types of belt lacing machines on the market any of which will prove satisfactory.

Directions for Making Cement Splices

First cut a surface on one end of the belt to a feather edge, using a small block plane or a scarfing machine, taking care to have the lap pointing in the same direction as other laps in the belt. Mark off the position of the lap on the other end of the belt and cut the surface in the same manner, then scrape each lap smooth with a slicker.

Length of Splices

The splice in no instance should be less than nine inches long for double belts. When the belt exceeds nine inches in width the splice should be as long as the belt is wide up to 18 inches. No splice need exceed 18 inches in length.

Sizing and Gluing Laps

First size each of the laps with thin belt glue, then apply the belt glue as rapidly as possible but not too thick, and immediately bring the laps together and hammer them all over, using a shoemaker's hammer, to insure close contact at all points. Then place the lapped joint in a belt press, or place rubber-faced shoes on either side of the belt, covering the splice and draw them tight together with hand screws. Let the belt set in the press from fifteen minutes to an hour.

Glue

The best glue is a glue that should be applied hot to the splices. But there

may be emergencies where there is not sufficient time to heat the glue, and for such cases a cold glue should be kept on hand ready for use.

Direction in which Belts Should Run

Belts should run so that the feather edges of all laps on the side next to the pulley point away from the pulley as the belt approaches it.

Reclamation of Old Belts

Where belting has been damaged on the edges it should be cut down to a narrow belt. Short pieces should be cleaned, scarfed and glued together. This will result in a considerable saving.

Tension of Belts

In accordance with the most approved rules for belting, based on scientific investigation covering a period of years, 190 pounds per square inch of section was adopted as the maximum tension under which belts would develop their highest efficiency, all things considered, and means were provided for weighing the tension of belts when put into service and for subsequently tightening them when the tension falls to a minimum at which a belt will do effective work. Both the maximum and minimum tension for any width and thickness of a belt are obtained, without calculation, from Barth's belting slide rule. The velocity at which a belt will run over a pulley of given diameter and the horsepower with reference to the width, thickness and arc of contact can also be read from this slide rule. The slide rule is arranged for defining the tension of either countershaft or machine belts.

The Newall Standard Metric Allowances for Various Fits

We published some years ago the Newall Standard Tables of allowances for various classes of fits, which had been worked out and adopted by the Newall Engineering Company, Black Horse Lane, Walthamstow, London, E., England. These were in English inches and used in many places.

This company has now worked out the table of allowances for use in connection with metric measurements; the allowances show these in decimals of a millimeter. These are printed on an attractive card and copies will be sent to our readers by the Newall Engineering Company, upon application.

The Newall system is based on a hole "basis," which means that all holes are produced as near the standard size as commercially possible and the allowances are made in the shaft or other fitting. The first table shows the tolerances allowable in a standard hole for two grades of work which are designated by classes A and B. Tables 2, 3, 4 and 5 show allowances for various kinds of fits.

Table 2 is for shafts which will require hydraulic pressure to force them into the holes or heating for shrinkage. Table 3 will require the shaft to be driven into place. Table 4 is known as a push fit in which the piece can be forced in quite easily but is not free enough to rotate. Table 5 is suitable for running fit for engine and other work, where easy fits are required. Table 6 is suitable for high speeds, and good average machine work, while table 7 is suitable for fine tool work.

The tolerance in each case is the difference between the high and low limits and represents the working margin.

Nominal Diameters.	Up to 15	16–25	26–50	51–75	76–100	101–125	126–150
High limit	+0.007	+0.013	+0.019	+0.026	+0.026	+0.026	+0.039
Low limit	—0.007	—0.007	—0.007	—0.013	—0.013	—0.013	—0.013
Tolerance	0.014	0.020	0.026	0.039	0.039	0.039	0.052
High limit	+0.013	+0.019	+0.026	+0.032	+0.039	+0.045	+0.051
Low limit	—0.013	—0.013	—0.013	—0.019	—0.019	—0.019	—0.026
Tolerance	0.026	0.032	0.039	0.052	0.058	0.064	0.077

Table 1. Tolerances in Standard Holes for Two Grades of Work.

Nominal Diameters.	Up to 15	16–25	26–50	51–75	76–100	101–125	126–150
High limit	+0.026	+0.051	+0.102	+0.153	+0.204	+0.255	+0.306
Low limit	+0.013	+0.038	+0.077	+0.115	+0.152	+0.203	+0.254
Tolerance	0.013	0.013	0.025	0.038	0.052	0.052	0.052

Table 2. Force and Shrink Fits.

Nominal Diameters.	Up to 15	16–25	26–50	51–75	76–100	101–125	126–150
High limit	+0.013	+0.026	+0.039	+0.064	+0.077	+0.089	+0.102
Low limit	+0.007	+0.019	+0.026	+0.039	+0.051	+0.063	+0.076
Tolerance	0.006	0.007	0.013	0.025	0.026	0.026	0.026

Table 3. Driving Fits.

Nominal Diameters.	Up to 15	16–25	26–50	51–75	76–100	101–125	126–150
High limit	—0.006	—0.006	—0.006	—0.012	—0.012	—0.012	—0.012
Low limit	—0.019	—0.019	—0.019	—0.026	—0.026	—0.026	—0.026
Tolerance	0.013	0.013	0.013	0.014	0.014	0.014	0.014

Table 4. Push Fits—Go in Easy but Will Not Turn.

Nominal Diameters.	Up to 15	16–25	26–50	51–75	76–100	101–125	126–150
High limit	—0.025	—0.032	—0.045	—0.051	—0.063	—0.076	—0.089
Low limit	—0.051	—0.070	—0.090	—0.108	—0.127	—0.146	—0.165
Tolerance	0.026	0.038	0.045	0.057	0.064	0.070	0.076

Table 5. Running Fits for Engine and Similar Work.

Nominal Diameters.	Up to 15	16–25	26–50	51–75	76–100	101–125	126–150
High limit	—0.019	—0.025	—0.032	—0.038	—0.051	—0.057	—0.063
Low limit	—0.032	—0.051	—0.064	—0.076	—0.089	—0.101	—0.114
Tolerance	0.013	0.026	0.032	0.038	0.038	0.044	0.051

Table 6. Running Fits for Good Average Machine Work.

Nominal Diameters.	Up to 15	16–25	26–50	51–75	76–100	101–125	126–150
High limit	—0.012	—0.019	—0.019	—0.025	—0.025	—0.032	—0.032
Low limit	—0.019	—0.032	—0.039	—0.051	—0.057	—0.064	—0.070
Tolerance	0.007	0.013	0.020	0.026	0.032	0.032	0.0[illegible]

Table 7. Running Fits for Fine Tool Work.

THE NEWALL STANDARD

Tables of Allowances for Various Classes of Fits—in Millimeters.

From statistics compiled by the Department of Commerce and Labor, exports of metal-working machinery, tools and electrical machinery during the month of January amounted to $1,100,000. For the seven months ending with January, 1910, the exports of these same commodities reached $10,000,000.

Machining a Clutch Gear

By E. A. Dixie

The Brown-Lipe Gear Company, Syracuse, N. Y., had an order for about 1000 of clutch gears, four operations on which are shown in Fig. 1.

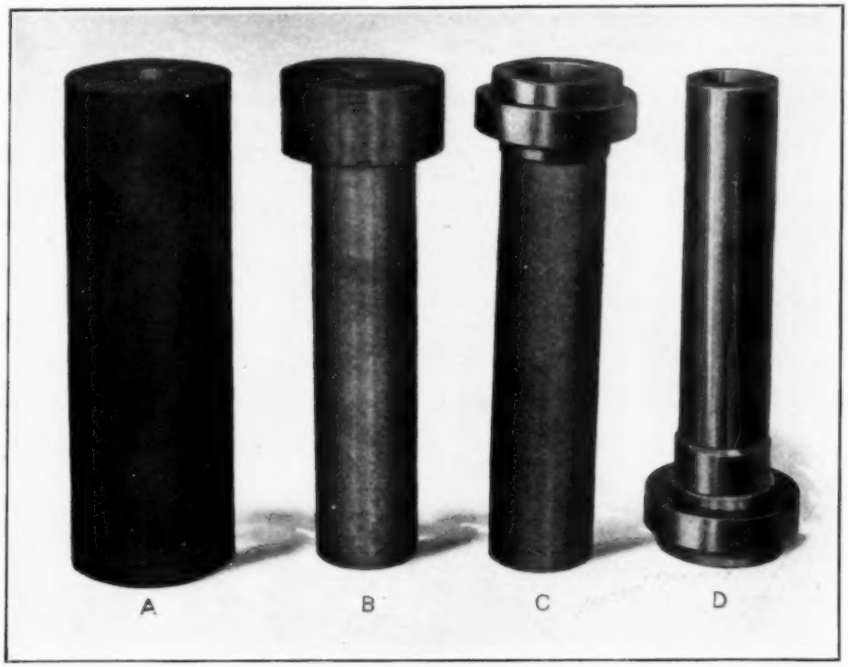


FIG. 1. FOUR OPERATIONS IN MAKING THE CLUTCH GEAR BLANK

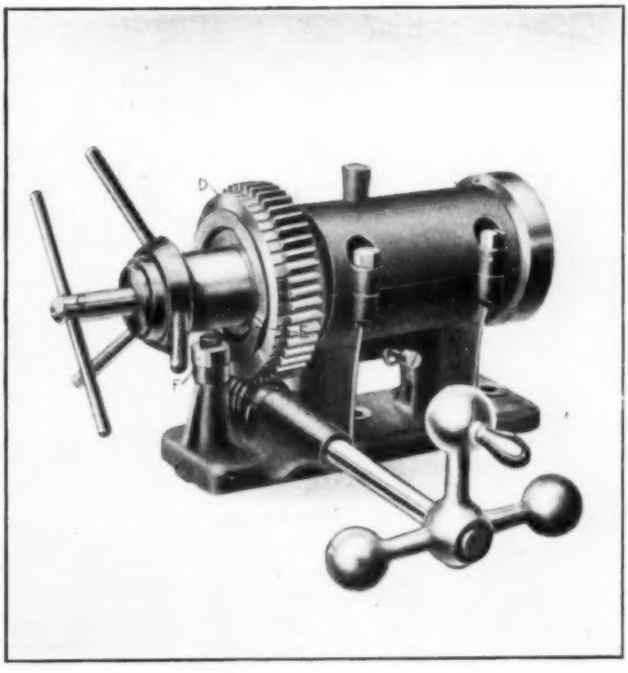
Obviously they ought to have been made from forged blanks, but bar stock could be obtained at once and it was decided that several hundred could be made before forgings could be obtained.

The stock is 3½ per cent. nickel steel. The bars, 3½ inches in diameter, are cut in a Cochrane-Bly cold saw into 10-inch lengths. From the cold saw, after centering, they go to a Foote-Burt drill press where they are gripped in a three-jaw chuck and a drill is run in from each end so that the cuts meet in the middle. It is remarkable how close the two drillings match up. The work on the drill press averages 30 finished pieces per 10-hour day. The piece marked *A* in the halftone is as it leaves the drill press. From the drill press the pieces are taken to a Springfield 16-inch engine lathe. Here they are rough-turned, as shown at *B*, being reduced to 2⅛ in one cut. The engine lathe turns out the pieces *B* at the rate of 20 in 10 hours.

From the lathe the pieces go to the Jones & Lamson flat turret where the large end is turned, faced and bored at the one setting, leaving the pieces as shown at *C*. This operation is done at the rate of 22 per 10 hours.

The final operation is also done on the flat turret. The chuck which holds them consists of a hardened and ground stub mounted on the spindle and which fits accurately the hole in the large end of the piece *C*. The upper face of the large flange of *C* bears on a hardened and ground face and a hardened and ground nut is slipped over the small end of *C* and screwed on to the body of the chuck drawing the piece *C* hard up against the chuck. In this position the piece is finished at the one setting. The hole in the end being bored and reamed in line with the hole in the large end and the outside of the small end finished to size. The piece *D* is produced at the rate of 12 in 10 hours and they are true to within a limit of 0.0015 inch.

Subsequently teeth are cut on the large flange and a clutch is cut on the extreme of the large end. The teeth are cut in



FIGS. 2 AND 3. THE RATCHET MILLING FIXTURE

a Fellows gear shaper, 30 of the gears being a day's work.

The clutch on the end is cut in the fixture shown in Figs. 2 and 3, mounted on a Hendey milling machine. The clutch is drawn into the centering ring *A* by means of the threaded washer *B* and the handle *C*. The worm wheel *D* is mounted on the spindle and formed on its face is the ratchet cam *E*, which rides on the roller *F* as the spindle is rotated. A spring, not shown, keeps the spindle and its affixed cam *E* back against the roller *F*. With this device 50 clutches are milled in 10 hours.

Reboring Valve Seats, Machining Engine Ports *By B. Lawrence*

Like most other shops doing repair work, we often find ourselves up against a job which is too large for our machines, or which for some other reason cannot be tackled by ordinary methods. The sketches show two jobs of this character and the means used for getting over the difficulties presented.

In Fig. 1 is shown part of a gas engine, which had the exhaust-valve casing and seat cast in one piece with the cylinder. The valve seat was so badly worn as to require refacing. A boring bar in a radial drill would probably have been the best thing to use, but as one was not available, to save taking the engine to pieces we did the work by hand power, using the fixtures shown.

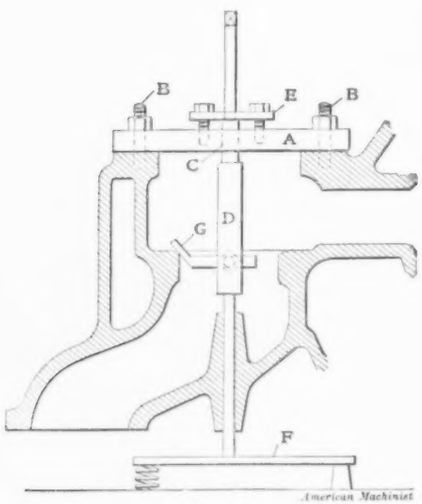


FIG. 1. REBORING VALVE SEATS

The plate *A* was drilled to fit on the two cover studs *B*; the hole *C* marked off central with the bore of the valve casing and drilled, and the top plate *E* drilled and fitted with set screws. The cutter bar *D* was turned at the lower end to fit the valve guide, and at the top to fit plate *A*, with a shoulder for plate *E* to rest on. The top end was squared to take a big tap wrench, and when in use the bar was held up by the board *F*; under one end of which was a spring.

A flat facing cutter was first used to reduce the width of the worn seat, the cut being put on by screwing down plate *E*. Then the seat was finished with the cutter shown at *G*. This was thinned at the cutting part so as to have a certain amount of spring. It had a fairly acute cutting angle, and very little clearance.

The valve seat was 5 inches in diameter, and was a thoroughly good job; very little grinding being needed to produce perfect contact with the valve.

In Fig. 2 are shown the two cylinders of a compound steam engine, cast in one piece, which had to be rebored and remachined on the faces of the ports. The boring was a straightforward job for the lathe, but the facing required some thinking as we had no slotter and only a small planer. Deciding to use this, we secured the cylinders to the end of the bed in the manner shown.

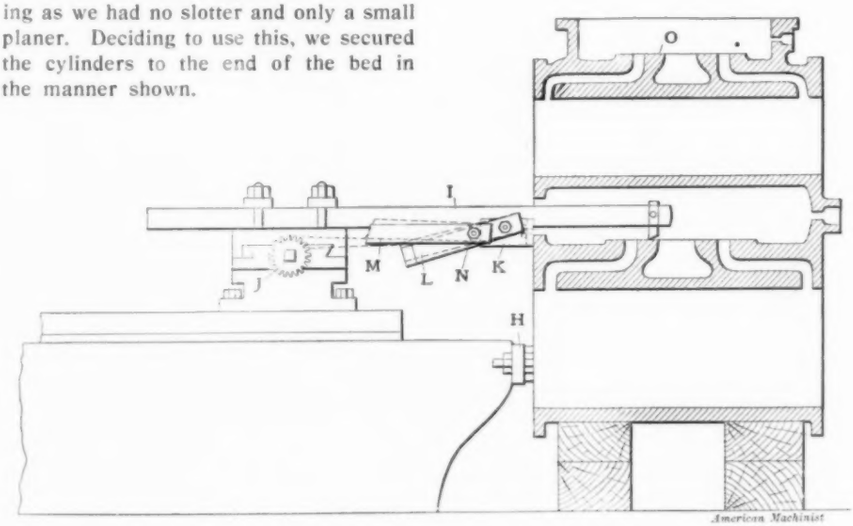


FIG. 2. REMACHINING THE FACES OF ENGINE PORTS

The bar *H* was drilled to go on two of the cover studs and was fixed to the planer bed by set screws; the cylinders being leveled up on packing to a convenient hight, with the valve faces parallel with the table. A stiff slide rest was borrowed from a lathe and bolted on the table, and in this was clamped the tool bar *I*. This was a piece of 2½-inch shaft and was handier than a square bar as it allowed the tool to be inclined first to one side and then to the other, so as to get at the whole of the valve face.

There was, of course, no down feed, but the tool was set the proper depth in the bar to take a light cut. The cutting edge was toward the planer so that the tool cut on the slow stroke. At first the tool was fed by hand but after a little while, thinking an automatic feed would be preferable, we fixed up the arrangement shown.

The ratchet wheel *J* was borrowed from a shaper and fixed on the slide screw. The three plates *K*, *L* and *M* were lying ready to hand, they being ordinary clamping plates, two with the ends turned at right angles. *K* was held by a stud in the cylinder end, *L* was bolted tightly to *K*, and *M* was attached to *L*, it being free to swing on the bolt *N* and was held up the required amount by the end of *L*. As the slide approached the cylinders the end of *M* caught the teeth of the ratchet wheel and revolved it a fraction of a turn. The amount of the feed was easily regulated by setting the lower end of *L* up or down, as indicated by dotted lines. This arrangement needed very little getting ready and was well worth while on account of the more regular feed.

The top valve face *O* was afterward machined in a similar manner, except that the job was reset as low as possible, and the slide rest packed up so as to bring the tool bar over the top of the flange.

According to the *Metal Industry*, the following recipe for a nonshrinking alloy, useful in duplicating patterns, gives good results: Tin, 50 pounds; zinc, 50 pounds. This gives a tough, hard metal that runs well if a good grade of zinc is used. The addition of 2 pounds of bismuth will render it even more fluid and enable it to be poured at a lower temperature. By using heavy sprues and pouring cold, the shrinkage, which is slight, may be largely overcome.

Some of the Methods Used in Building the Locomobile

Fixtures and Tools for Handling the Various Parts of the Car

By Fred H. Colvin

Those who recall the early days of automobile building in this country will remember the hundreds of small steam-driven machines, which were pioneers in the industry. These, long ago, gave way to a substantial gasolene-driven car, which also bears the name of "Locomobile," and which has given a good account of itself in several of the important speed trials.

The manufacture of this car has been carefully worked out, and the methods are based on modern ideas in shop practice. One of the principles is that all machine as in the case of laying out fixtures or other work where it is necessary to have the greatest accuracy in the machine itself.

Manganese Bronze Crank Case

This is the engine base, which is the only one we know of made of manganese bronze and having a tensile strength of 85,000 pounds. The Locomobile people have found this more satisfactory than aluminum in every way, although it is much harder to work. It is claimed that the aluminum engine base gives or warps face off the end around the holes to the correct length.

This has been found necessary to secure the desired accuracy, as if these are faced at the same setting as when they are bored, the expansion of the engine base from the heat generated in boring it, is enough to affect its accuracy when cold. After facing one end the whole fixture is turned so as to have the other end faced perfectly square with the first, the fixture being located by the index pin shown.

Another boring operation on one of the

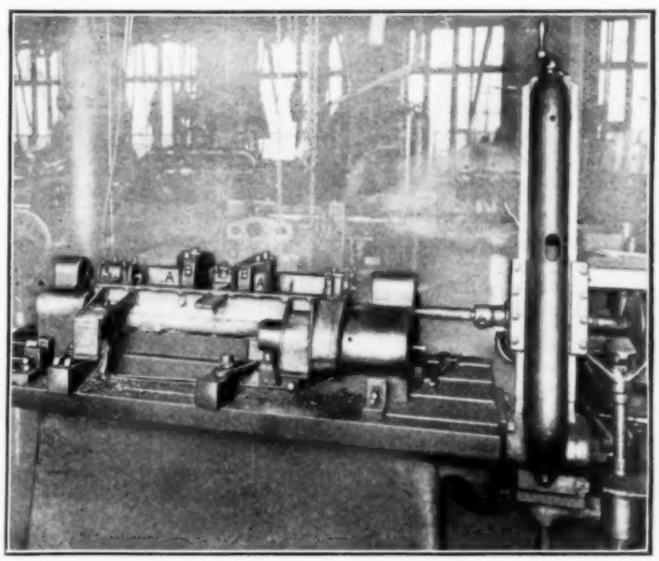


Fig. 1. Boring the Bronze Engine Base

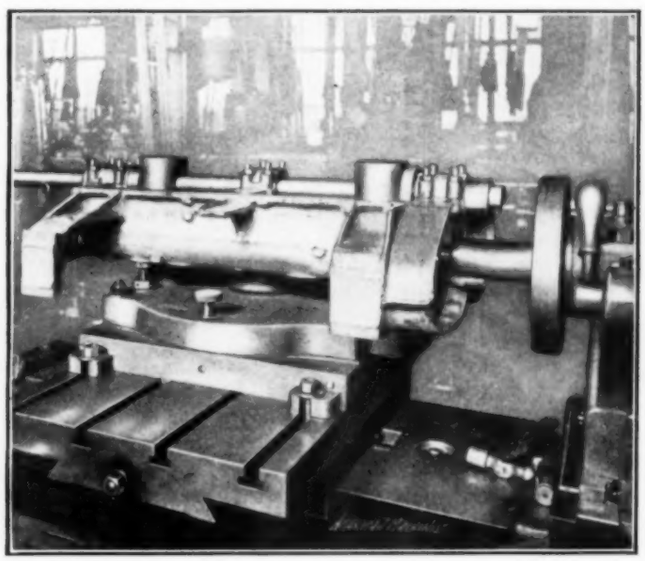


Fig. 2. Squaring the Ends of Base

holes must be located by jigs and fixtures, no matter how unimportant they may be, this being extended to the holes for the spring clips on the axles and other similar places. While this might be considered going to extremes in some instances, the object is to be able to make any desired change or attachment and know that it will fit cars which are already in use, or parts which are under construction in the shop.

Bearing this principle in mind we can readily see why the boring of the crank case is done on a comparatively light machine, a Barnes horizontal drilling machine in this case. It must be remembered that the only function of the machine is to support the work on its table, and rotate the bar which is driven through universal joints, and does not depend upon the machine in any way for its alinement. Consequently it is unnecessary to drive it with an expensive under the varying strains from the cylinders, and that the use of bronze has justified its expense in their case.

The fixture is of very substantial design, the central boring-bar support *A A* coming up through the holes in the top of the base, and the auxiliary supporting arms *B B* are located by a doweling rib, and held by the cap screws shown. These supports carry bushings for the bars which bore the side holes for the hand and pump shaft.

After the holes have been bored as in Fig. 1 the case goes to an adjoining horizontal boring machine as shown in Fig. 2, and is placed on a fixture which locates it by the two end bores for the engine cylinders, and the locating bar which passes through these supports, and also the three crank bearings shown. This holds it rigidly in line with the holes already bored, and allows the facing milling cutter in the end of the spindle to Barnes machines is shown in Fig. 3 where the bronze bracket for the steering worm and wheel are being bored in the double fixture shown. This fixture is fastened to the table and after one hole is bored the fixture is turned 90 degrees and the other hole bored at the same setting. Each hole has its special boring bar as can be readily seen. They are then hand-reamed to secure the exact size desired.

Boring the Pistons

Fig. 4 shows how the pistons are bored after being turned, and is an excellent example of the precautions necessary to prevent springing in handling cast-iron work. The piston head bears against the face of the chuck *A* in a shallow recess which serves to center it, and is held against this face by the four-strap jaws *B*, which fit into the first piston-ring groove. Under these conditions it would seem hardly probable that the piston

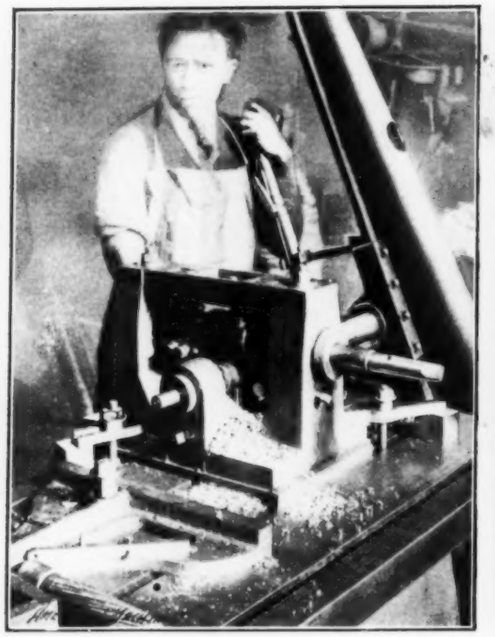


FIG. 3. BORING STEERING-GEAR CASE

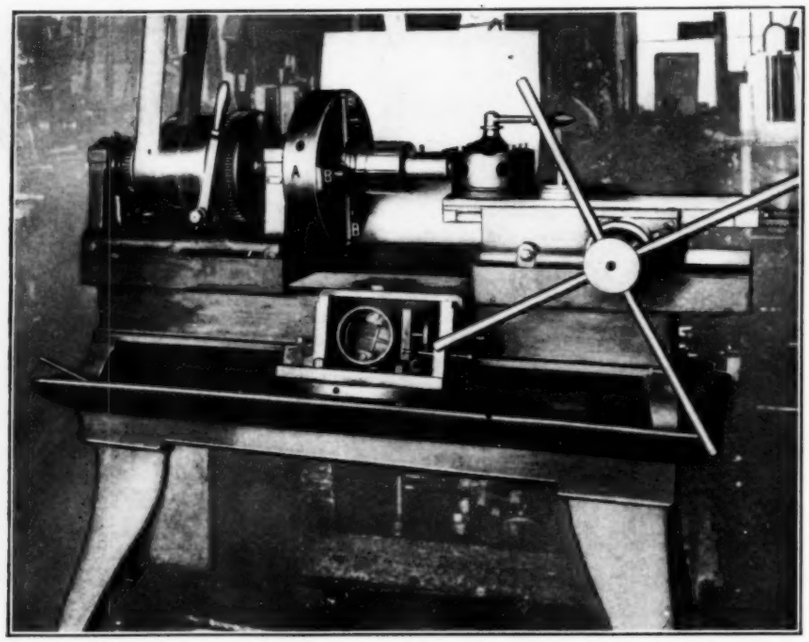


FIG. 4. CHUCK FOR BORING PISTONS

would be sprung at its outer end, yet this was the case until the chuck body was made very heavy as shown and it is now one solid mass of cast iron instead of being cored as is usual. Until this was done it was found that chuck body was run out of true, even with the thumb nuts shown, so as to affect the accuracy of the piston at the outer end when it was released from the chuck.

The chuck shown in front of this machine was formerly used for boring the cross or wristpin holes in the piston, these mounted on the lathe shown and the boring tool being held in the turret. The piston was located by the piece *C* which has a V grooved in its face, fitting against the bosses of the inside of the piston, and locating it so that the bushing in the front of the fixture would bring the wristpin hole in the right place.

This method had given way to that shown in Fig. 5 in which the piston is held in the clamping fixture shown and the boring bar shown front is used after a preliminary hole has been drilled to allow passage of the front end of the bar. This bar is also driven by universal joints as can be seen, and the accuracy of the hold is insured, while a fairly rapid output is the result.

BORING THE CARBURETER

Fig. 6 shows an interesting chuck used on a Bardons & Oliver fox turret machine for locating and boring two openings in the carbureter body. As shown, it is set for the small hole and by loosening the nuts shown, taking off the counterweight *W* and swinging the plate with the jaws holding the work, to its other position, the main opening is brought central with the spindle and in position to be bored at exactly the right distance from the small hole. This plate has a projection *A* which stops against hardened steel locating pins, one being shown at *B*. Fixtures of this kind are not as common in connection with brass work as they should be, and modification of this can be applied very widely.

Crank shafts are received in the forgings at machines all over in the shop. They are first rough turned in the usual way and then go to the milling machine as indicated in Figs. 7 and 8. The sides have already been milled with a slab milling machine, and Fig. 7 shows how the cheeks are rounded off at each side of the crank pin, a pair of form cutters being used as shown. The holding fixture supports the crank shaft firmly.

From here they go to the vertical milling machine shown in Fig. 8 where the long conical cutters mill the whole side of the cheek leaving only the short angle at the upper part to be milled in a similar machine, and with a milling cutter having a different angle. The crank shafts are then sent to the grinding machines and all the bearings finished in this way. After being ground they are

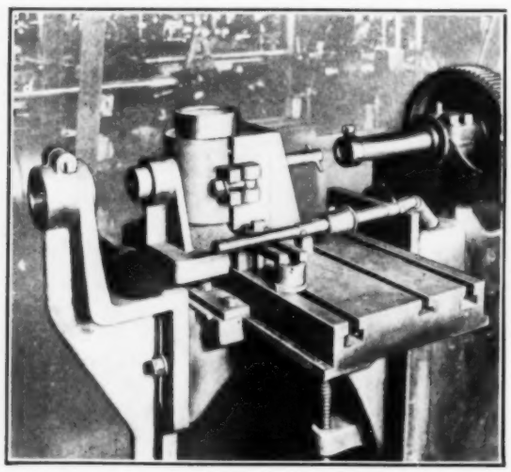


FIG. 5. BORING PISTON HOLES

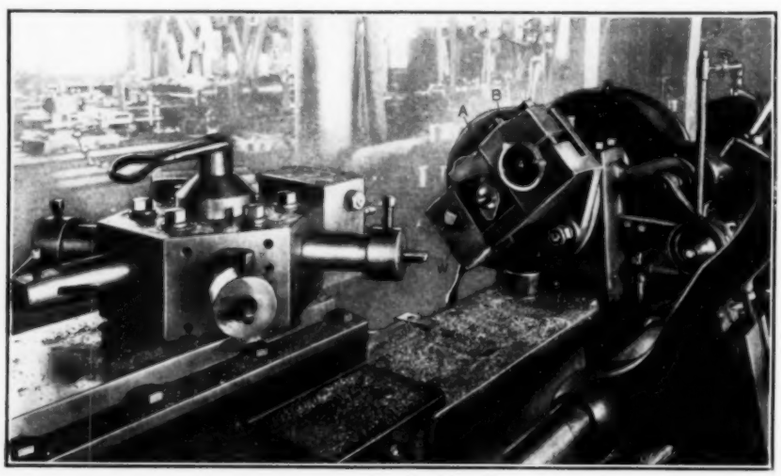


FIG. 6. SHIFTING CHUCK FOR CARBURETER BODY

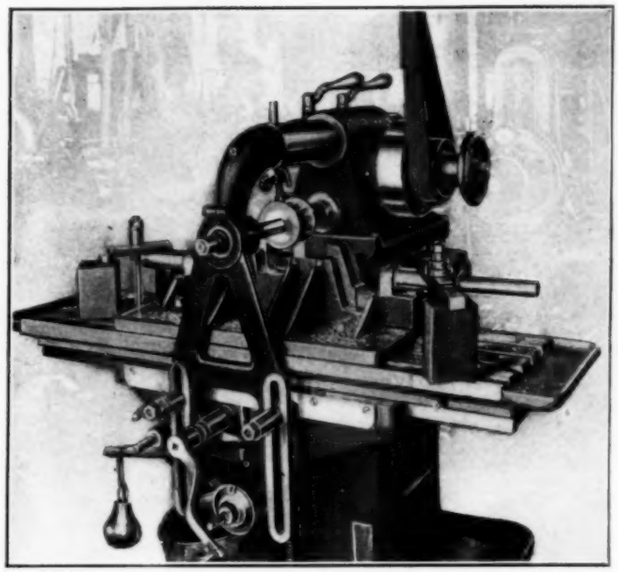


FIG. 7. MILLING TOPS OF CRANKS

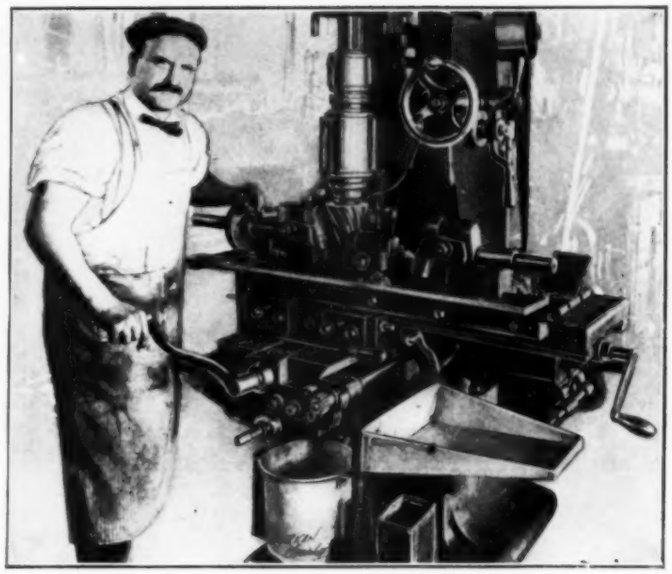


FIG. 8. MILLING THE CRANK CHEEKS

protected by having a strip of manila paper wrapped around each bearing, and fastened with mucilage or glue.

HANDY DRILLING FIXTURE

Fig. 9 shows a very convenient post drilling machine of the double-arm or elbow type which is countersinking at drilling small holes in the engine base. The base is swung in a very handy fixture which enables it to be tipped at any desired angle, and this, in connection with the flexibility of the drilling arm, allows work to be handled very rapidly. The pressure is applied by the lever above the drilling spindle, so that the upward thrust is rarely taken by the operator.

Fig. 10 is a large Potter & Johnston machine equipped with special tools on the cross slide for turning the various angles on the large double gear used in the rear-axle differential. These are of chrome-nickel steel and it has been found better in every way to take a series of small chips, rather than attempt using a broad-face cutter. These individual tools are mounted in the tool-holding bars which can be seen projecting from the slide, and these are automatically moved so as to turn every angle to exactly the right degree, it only being necessary for the operator to handle the work after the tools are properly set. It is also their custom to turn a narrow flat face on the inner edge of the face angle to be used in truing the gears after hardening.

HANDLING AUTOMOBILE CYLINDERS

There are various ways of handling automobile cylinders, some first facing off the flange and one edge and working from these, others drilling the flange for the bolt and locating from these bolt holes, but the Locomobile practice is to first mill the side outlets as shown in Fig. 11 and work from these. Outlet *A* is the locating point for all future operations, and the rough cylinders are placed in the fixture shown, which is a different procedure from any I have seen. The flange fits in the yoke at the left and other end is supported by the fixture *B* which has a double-cross movement as can be seen. This centers the upper end of the cylinder bore by its cone centering cups and the outside of the cylinder bore is centered at the point marked with chalk by a surface gage used on the milling-machine table. After this is done the

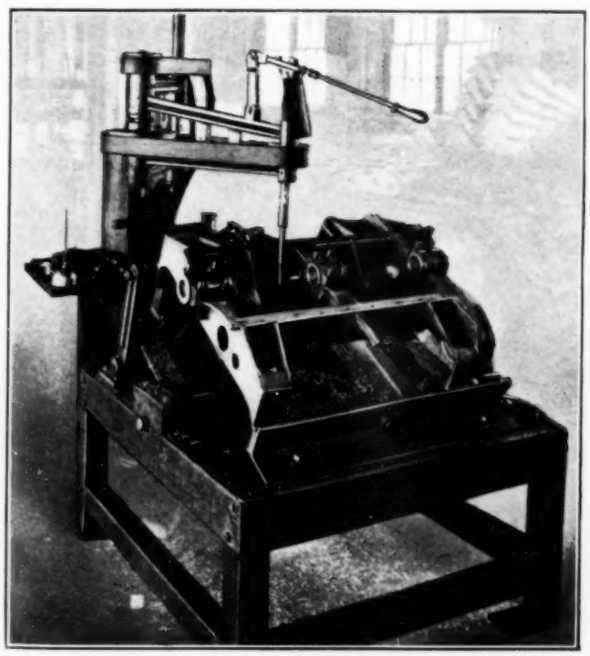


FIG. 9. CONVENIENT DRILLING MACHINE

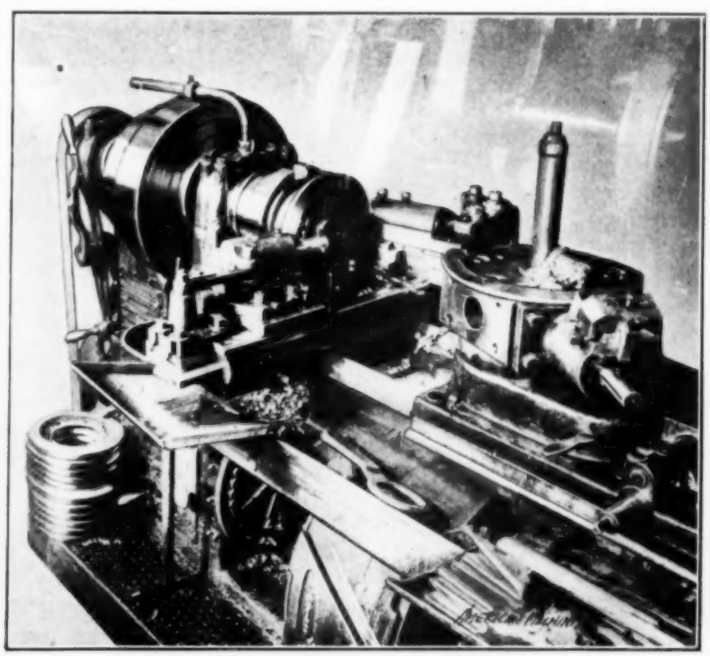


FIG. 10. TURNING BEVEL-GEAR BLANKS

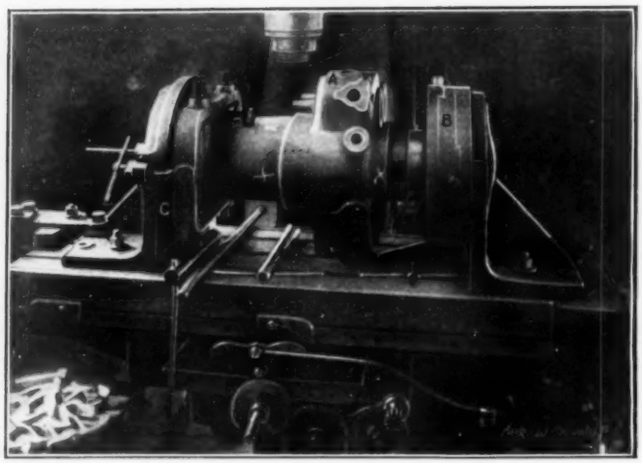


FIG. 11. CYLINDER-LOCATING FIXTURE

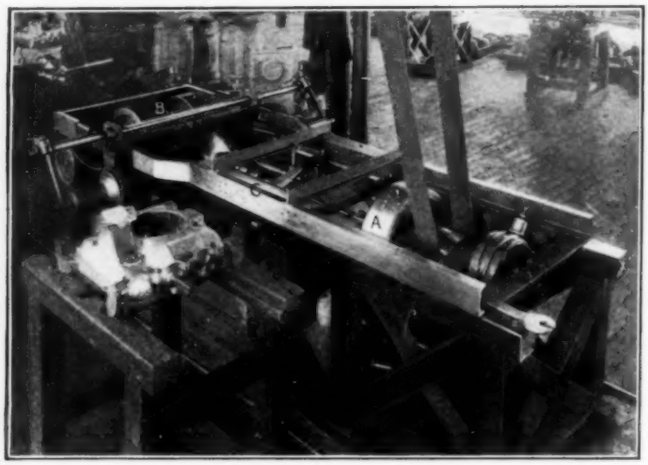


FIG. 12. TRANSMISSION TESTING FRAME

outlet *A* is first milled, then the whole cylinder and fixtures are turned on their axis until the next side outlet comes into position. These various points are located by index pins in the fixture holding the cylinder flange, and instead of depending on these pins the fixture is drawn together by the clamps *C*, one on each side.

From here the cylinders go to the large Beaman & Smith boring machine which has two boring bars at one end, and a large milling head at the other. The cylinders are placed so that the opening *A* rests on a hardened steel grip in the cylinder-holding fixture, and are held in position by suitable clamps or traps which support the cylinder at the various points. The flanges are first faced off with the milling cutter previously referred to, and the whole boring-machine table revolved so as to bring the pairs which have been faced to the boring cutter. Two sets of boring bars are used, the cylinders being roughed and finish-bored at the one setting, after which they

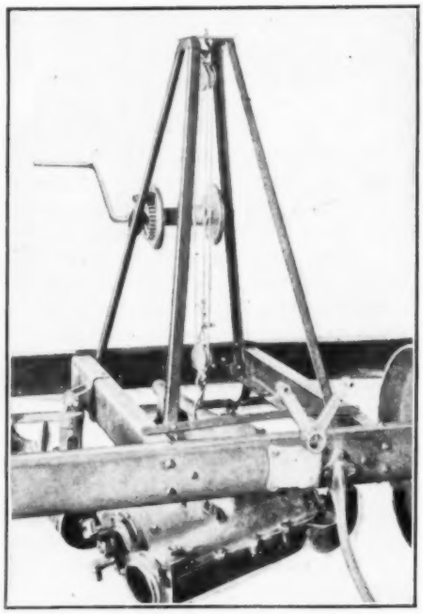


FIG. 14. LIGHT PORTABLE CRANE FOR ASSEMBLING

are ready to be ground on a Heald grinder as is common practice.

Fig. 13 shows the way in which the cylinders are held on the large Beaman & Smith boring machine, while they are being bored and face milled. These are very simple holding fixtures and although not clearly shown the cylinders are located or centered from both ends. The back end centering device is similar to that shown in Fig. 11, where the sides of the cylinders were being milled in a special fixture and the outer end of the bore is easily centered with relation to the boring bar. It then is an easy matter to clamp them into place and to bore and to space mill them at the same setting so the space of the plan is bound to be square with the bore.

Fig. 14 shows an interesting little portable crane which is used in the assemblage department for handling the transmission cases and similar work. This is easily made up of the small angle iron as shown and it is equipped with a cast-iron spool and with a ratchet wheel which is simply an old gear wheel, to

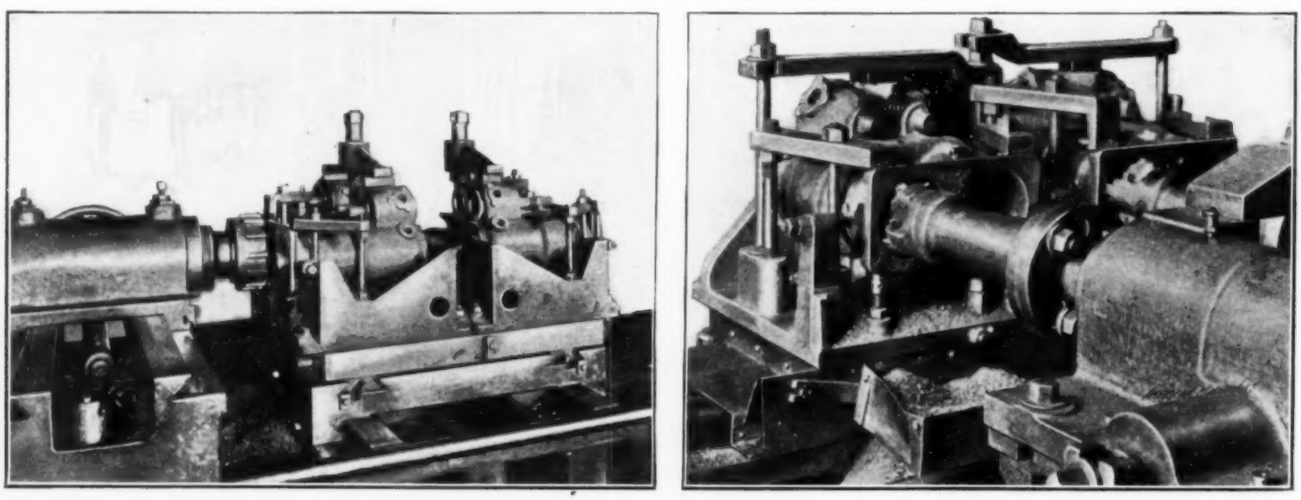


FIG. 13. TWO VIEWS OF CYLINDER-BORING FIXTURE

hold the load in any desired position. The small crane is simply placed on the chassis so that it is supported by the two cross levers and the transmission is hoisted into place and held in any desired position without the aid of a helper as was formerly required.

Valve Lapping Device

Fig. 15 shows an extremely interesting little device in use for grinding or lapping the valves into their seats. It has a taper shank which fits a regular drilled socket and this drives a pinion *A*, which in turn drives the gear *B* which is fastened to the cam plate *C*, seen below it. The path of the cam groove is shown in the upper view in dotted lines from which it will be readily seen that in grinding, the little arm which drives the valve does not revolve but simply oscillates through the arc shown, being governed by the maximum and minimum radius of the cam groove with relation to the center of cam disk. This gives a rapidly oscillating movement to the valve being ground. The valve grinding spindle *G* has a ball thrust bearing shown, and the whole device can be operated in any convenient drilling machine. It has proved very satisfactory in this case.

Fig. 12 shows the testing frame for transmissions, and both rear axle and chain-drive gearing for the car drives. Power is applied through a clutch *A* of the regular type used in the car, is transmitted to the driving mechanism as shown, and a load put on by the brake *B* in between the two pulleys on the rear angle which is driven by the chain shown. The load on this brake can be varied so as to represent different load conditions and the object of the heavy pulleys is so that the load can be removed and let these represent the coasting of a car down hill. It sometimes happens that gears will be quiet under load and noisy when running free as in coasting, and this allows this defect to be detected before they are put into the car.

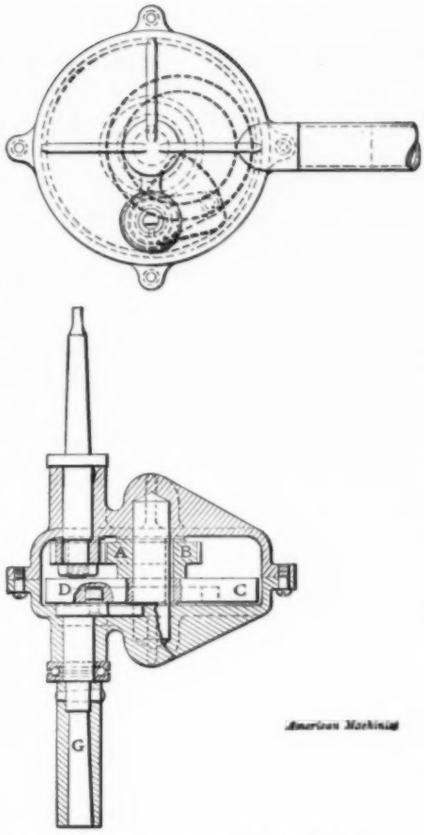


Fig. 15. Details of Valve Grinder

Transmissions are supported at *C* under the two inverted cross T-beams in the center of the machine, and the brake at the front end is simply to overcome the momentum of the flywheel in the clutch.

Bevel Gears

Considerable attention has been paid to the grinding of the hold in both bevel and spur gears, so as to bring them as nearly concentric with the pitch diameter as possible after hardening. Small gears spring very little in hardening, but on the large double gears used in the differentials, this is quite noticeable. By having the flat face at the upper or inside end of the face angle, as referred to in connection with the machine for turning these gear blanks, they are enabled to straighten these after hardening as they have a plain surface to work from.

This straightening is done by hand as it has been found much more satisfactory than any hydraulic or other method of doing this by machinery.

Broaching

Broaching is used to a large extent and considerable experimenting has been done to determine the best form of broach for both low-carbon steel and also such alloys as chrome nickel. The broaches are designed to remove about 0.001 inch per tooth in chrome nickel steel on cuts of ordinary length, and from this up to as high as 0.007 in softer materials such as low-carbon steel and bronze.

An interesting operation is the broaching of the white-bronze bushings which are used for crank-pin bearings. After these have been put in place in the lower end of the connecting rod, a round broach is pulled through them which removes very little metal, and is perfectly plain for about four inches from the end. In this way the box is broached out and also burnished or expanded by beautiful finish, increasing the density of the metal and has proved highly satisfactory in every way. Needless to say it requires an enormous amount of power to pull the plain portion of the broach through the work.

Making Piston Rings

The Locomobile practice in making piston rings is interesting and somewhat unusual. The rings are first turned and clamped on a mandrel and are then rough ground to within 0.020 of finished size.

They are then strung together and held in a bell chuck to be bored. After boring they are again strung together and put on a mandrel for finished grinding. This gives very satisfactory results.

Heat Transmitting Properties of Copper Sheets

Prof. C. L. Allen in a paper presented to the American Society of Mechanical Engineers gives the following interesting data in regard to heat-transmitting properties of copper plates.

A series of tests has recently been made at the laboratories of the Worcester Polytechnic Institute to determine the relative heat-transmitting properties of copper sheets just as they are received from the rolling mill, and similar sheets electro-copper-plated. These tests were made with a view to increasing the capacity of dynamometers. The apparatus used consisted of two double-disk Alden dynamometers with the rotating cast-iron disks removed. The dynamometers as tested consisted of an outside cast-iron casing and four copper sheets, with the necessary spacing rings. The dynamometers were identical in every way, except that in one the copper sheets were electro-copper-plated.

	Plain Copper Sheets.	Electro-plated Copper Sheets.
	Degrees Fahrenheit.	Degrees Fahrenheit.
Average temperature of entering circulating water	44	44
Average temperature of exhaust circulating water	100	100
British thermal units per square foot per minute per 50 degrees difference in temperature of circulating water	467	610
Increase, in percentage	...	30.8

The dynamometers were set up so that the spaces normally occupied by the revolving disks were piped to the steam main. Plugs were removed from the top and bottom of these spaces so that all air and condensed steam would be removed. Circulating water was supplied at the bottom of the casings and taken out at the top, both the circulating water and condensed steam being collected and weighed. Thermometers were inserted in the steam line next to the dynamometers and in the water-supply line, also in the discharge of the circulating water and of the condensed steam. Several tests were run on each, of five minutes' duration.

The accompanying table gives results of these tests.

The results were all reduced to a common basis, namely: the British thermal units transmitted through one square foot of copper sheet per minute per 50 degrees difference in temperature of circulating water. The dynamometer containing the copper-plated sheets showed an increased heat transmission of more than 30 per cent. over the untreated. A probable explanation of this phenomenon is that when the sheets are electro-copper-plated, the copper is deposited in small globules and the actual surface not only is increased but is made rougher; this tends to mix up the water currents, bringing more new water in contact with the copper.

In the actual operation of the dynamometers, the heat is generated on a thin film of oil directly against one side of the copper and the water passes over the surface on the other side, carrying off the heat generated. It is a well-known fact that more heat is transmitted through copper than can be readily carried off by the water, and any increase in surface in contact with the water gives a corresponding increase in capacity. As the capacity of these dynamometers depends upon the heat-transmitting power of the copper sheets, it is clear that this capacity can be increased 30 per cent. by the use of electro-plated sheets.

A system of forced lubrication is essential for smooth running.

English Workman's Labor Exchanges

*By John L. Griffith**

The attention of the English people has been concentrated during the past few years far more upon domestic questions questions of social reform, questions concerning the comfort and contentment of the masses than upon questions of foreign policy. A great deal of legislation has resulted, the value of which can only be determined as the years pass by.

The Workmen's Compensation Law has been enlarged to include practically all classes of employees, and to embrace all manner of injuries, accidents and illnesses. An old age pension law has been enacted, the cost of which falls entirely upon the state and which required an outlay in the first year it was in effect of about $35,000,000. Laws have been passed authorizing county councils to acquire land under certain conditions for the purpose of subdividing it and then of selling or leasing it in small acreage.

A comprehensive measure for insurance against unemployment will, in all probability, be shortly introduced in Parliament, and on the first of February this year the state labor exchanges became operative throughout Great Britain.

The law creating the labor exchanges was passed in 1909, and is notable for its brevity and scope. The salient features are these:

That the British Board of Trade is authorized to establish and maintain, in such places as may be deemed advisable, labor exchanges, and may assist any labor exchanges maintained by any other authority or persons, and in the exercising of such powers may coöperate with any other authorities or persons having powers for that purpose.

The Board of Trade may also by such means as they think fit collect and furnish information as to employers requiring work people and work people seeking engagement or employment.

The Board of Trade is given the power to make general regulations with respect to the management of labor exchanges, but such regulations shall provide that no person shall suffer any disqualification or be otherwise prejudiced on account of refusing to accept employment found for him through a labor exchange where the ground of refusal is that a trade dispute which affects his trade, or that the wages offered are lower than those current in the trade in the district where the employment is found.

If any person knowingly makes a false statement or false representation to any officer of a labor exchange, or to any person acting for such exchange, for the purpose of obtaining employment or procuring work people, he shall be liable in respect of each offense on summary conviction to a fine not exceeding £10 ($48.66).

The following general regulations have been made to govern the operation of the exchanges:

The registration of applicants for employment is to hold good for seven days from the date of registration. The officer in charge of an exchange is to undertake no responsibility with regard to wages or other conditions, beyond supplying any information in his possession as to the rate of wages desired or offered. Copies or summaries of any agreements mutually arranged between associations of employers and workmen may be filed at a labor exchange, and any published rules may also be filed. Documents so filed are to be open to inspection on application. No person is to suffer any disqualification or to be otherwise prejudiced on account of refusing to accept employment found for him through a labor exchange where the ground of refusal is that a trade dispute which affects his trade exists, or that the wages offered are lower than those current in the trade in the district where the employment is found.

When an applicant for employment has been engaged through a labor exchange at which he is registered to take up employment at any place removed from the exchange or from his ordinary residence by more than five miles by the quickest route, or by such other distance as the Board of Trade may direct from time to time, the officer in charge may, at his discretion, make an advance to the applicant toward meeting the expenses of traveling to the place of employment. The advance may be made at the request either of the employer or of the applicant. The person at whose request the advance is made must give such undertaking with respect to the repayment of the advance as the Board of Trade may from time to time prescribe.

The question of strikes and lockouts was given very careful consideration by the framers of the general regulations, and the following rules have been adopted governing this matter:

Any association of employers or workmen may file at a labor exchange a statement with regard to the existence of a strike or lockout affecting their trade in the district. Any such statement shall be signed by a person authorized by the association for the purpose. Such statement shall only be in force for seven days from the date of filing, but may be renewed within that period, and so on from time to time. If any employer who appears to be affected by a statement so filed notifies the labor exchange of a vacancy or vacancies for workmen of the class affected, the officer in charge shall inform him of the statement that has been filed and give him an opportunity of making a written statement thereon. The officer in charge, in notifying any such vacancies to any applicant for employment, shall also inform him of the statements that have been filed.

It is believed that one of the principal causes of unemployment in Great Britain, and especially of the development of a class of unemployables, is the fact that so many boys leave school at the age of 14 years without having learned any trade or craft, and who do unskilled labor and depend upon casual employment, which is always uncertain and hazardous.

It is anticipated that the juvenile department of the labor exchanges will be able to direct many of the boys and girls, who now pass aimlessly from one employment to another, and thus early in life becomes social economic driftwood, to some healthy steady work which shall furnish opportunity for development and the building up of character.

*American Consul General, London.

Several things must be borne in mind in connection with labor exchanges in order to appreciate fully their purpose. They are not intended to be philanthropic, or to dispense alms in any form. They are not intended to create employment. They have nothing to do with the establishment of new industries, or the rehabilitation of old ones. The only motive for founding them was to diffuse a knowledge of local labor conditions throughout the entire country, and to facilitate the transfer or shifting of labor from a locality where it was idle to one where it could be profitably employed, and to provide a register of those who really desire to work, and to segregate them from the shiftless and incompetent.

"The central idea of the whole scheme," is stated to be that "continual contact shall be maintained, and that the information of 'wants' and 'wanted' shall be periodically passing up from a special locality to the central offices, and then be transmitted back to all the other localities."

Factory owners are availing themselves of the opportunities afforded by the labor bureau to secure workmen, and it is believed that if great care is exercised as to the quality of labor that is sent, a most advantageous reciprocal relationship will be established through the medium of these exchanges between labor and capital. Those who are most sanguine predict that these exchanges will do away with the hopeless quest of the workman of today in England who wanders from factory to factory and from place to place with a vague hope of finding employment, until in many cases of repeated disappointments he is utterly discouraged, and becomes perhaps a confirmed wanderer or tramp.

There will, of course, be periods of great stress when unemployment is general, and then labor exchanges can perhaps do little, but when conditions are normal they certainly should do much in bringing the workman and his work into conjunction, and of saving to both employer and employee much time that is now wasted by the employer in seeking competent workmen, and by the employee in trying to ascertain where employment can be found.

A Combination Boring and Facing Machine for Engine Beds

In the accompanying line cut is illustrated an interesting machine made by modifying a standard type so as to very greatly increase its rapidity of operation for turning out one particular product. This machine is used for boring the guide barrel, facing the flange and boring and facing the main bearings of small engine beds.

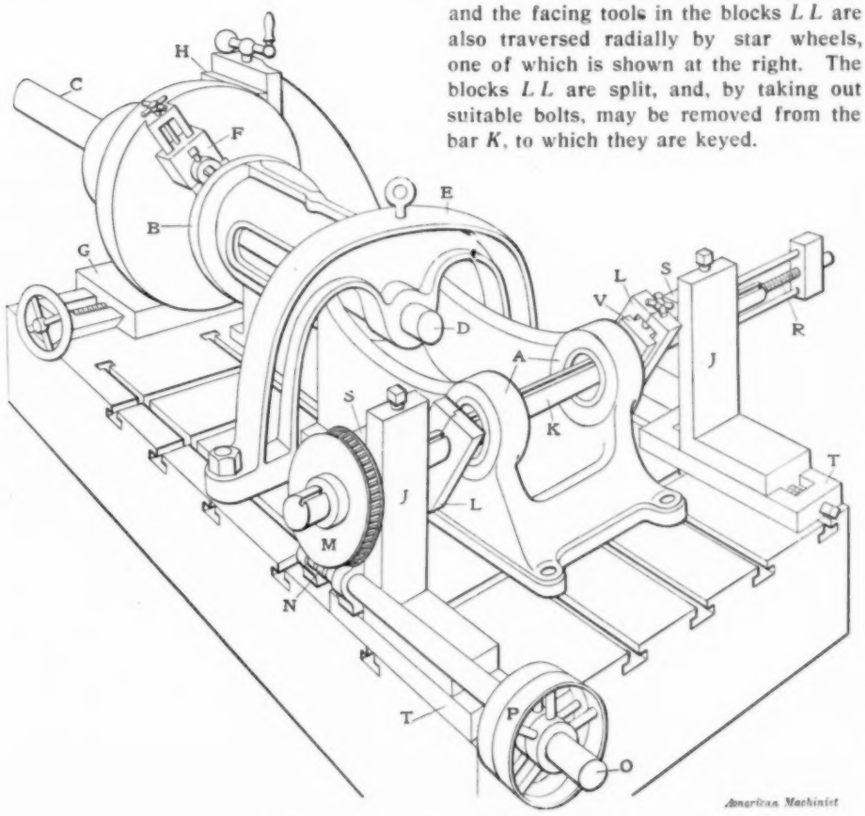
As seen from the cut, the boring bar *C D*, supported in the head carried on the guides *H* and *G* at one end and by the frame *E* at the other end, is boring out the cylindrical crosshead guide, while at the same time, the tool held in the tool block *F*, is facing off the flange *B*. While this is going on, the boring bar *K*, driven by the worm and wheel *N M*, and the pulley *P*, on the shaft *O*, is boring out the babbitted main bearings *A*. Also, by means of the facing arms *L L*, facing tools held in tool boxes, one of which is shown at *V*, are facing off the bearing ends.

The facing tool in the block *F*, is traversed radially by the star wheel shown at the top of the rotating guide and the facing tools in the blocks *L L* are also traversed radially by star wheels, one of which is shown at the right. The blocks *L L* are split, and, by taking out suitable bolts, may be removed from the bar *K*, to which they are keyed.

When boring by means of the bar *K*, the horizontal traverse is given to this bar by the screw *R*, which is held stationary in the head, at the right. The bar *K* is threaded internally and, consequently, as it rotates, it must travel along the stationary screw *R*.

Uprights *J J* are angle blocks and are adjustable horizontally in the guides *T T*, the latter being bolted down to the main bed of the machine. By means of the blocks *S S*, the hight of the bar *K* may be made to suit the work. With these various adjustments, engine beds of a very considerable range in size may be finished with this same machine.

Of course, the near end of the shaft *O* is supported by a separate bearing which is not shown in the illustration. This machine is in use at the plant of the Newburgh Ice Machine and Engine Company, at Newburgh, N. Y.



A Combination Boring Machine

A Good Truck-tongue

Frequently the trucks in use around the shop give trouble by failure of the wooden tongue or pole with which they are fitted. The usual tongue is bolted between two pieces of flat iron which in turn are made fast to the front axle of the truck. The front end of the tongue usually has a cross-piece mortised through it to form a good hold for the hand and it is a common thing to find one or both ends of the cross-piece broken short off. The wooden tongue soon gets "shackly" and fails to guide the truck properly. To cure this trouble, use a piece of ¾-inch or 1-inch black pipe in place of the wooden tongue. Drill two holes for the strap bolts, then drill one more hole close to the front end, put a ⅜-inch bolt through the pine tongue and two 6-inch pieces of pipe to form the cross-piece. Screw the bolts home and a tongue or pole is provided which will not break, split or come to pieces.

Three Cam Cutting Machines

By L. Freed

I am sending you three photographs illustrating the different methods of cutting cams in the shop of the National Machine and Tool Company, 253 A street, Boston, Massachusetts.

Fig. 1 shows a face and periphery cam being cut on this cam-cutting machine. Lying against the machine is another cam and leader which is also cut on this machine. Note that the position of the leader and roll is directly in back of the cam being cut, which does away with all spring and chattering troubles so common in cam-cutting machines.

The cutter leaves a nice smooth groove equally as well on periphery surface. Note also the slot in leader on floor and see how it is fastened to the traveling spindle of machine which insures no slipping of leader on spindle when once it is set. The groove in this cam is 1¼ inches wide by ¾ inch deep, by 12¼ inches smallest diameter, outside or periphery is 26 inches largest diameter. The cutters used for cutting the outside of this cam are of the shell type screwed on the tapered arbor shown. Standard-tapered and spiral-end mills are used for cutting the groove. The direct weight system is used on this machine.

Fig. 2 shows a much heavier cam-cutting machine with a 42-inch face cam being cut (groove not shown). The same method is used as in Fig. 1, i. e., the leader and roll being directly in back of cam being cut. At the lower right hand of machine is shown the feed pulley, which is connected by a belt (the belt and variable-speed controlling device is not shown, having been removed before photo was taken) to a variable-speed controlling device mounted on a countershaft and controlled by the operator with wheel shown directly over machine.

The arrangement of the wire rope on

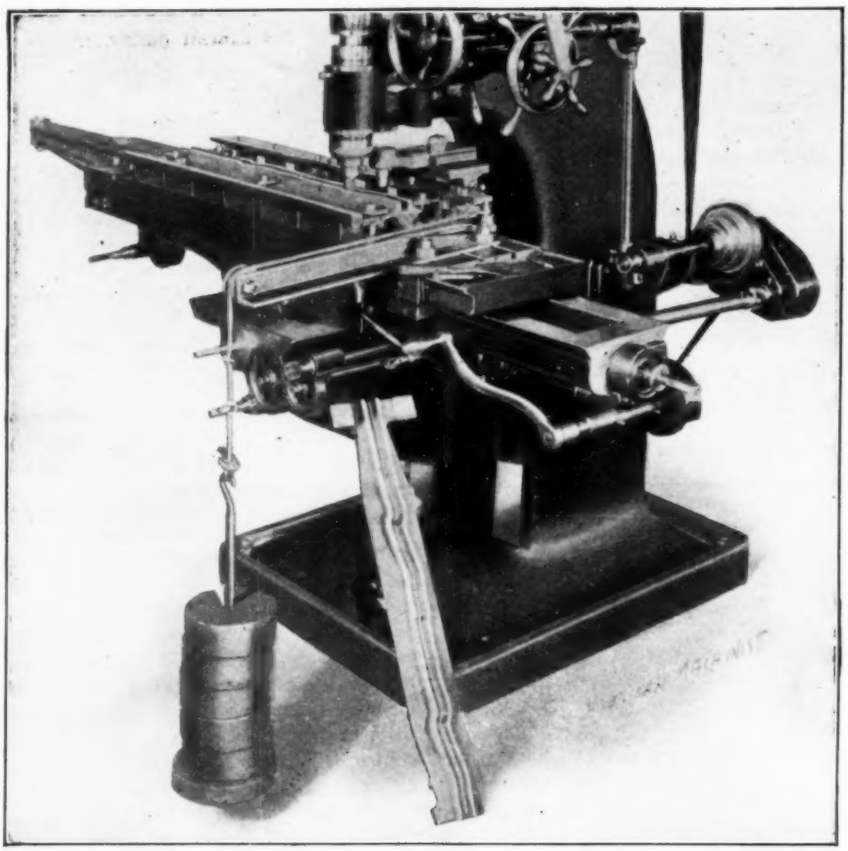


FIG. 3. BECKER MILLING MACHINE FITTED FOR CUTTING UNEVEN CAMS

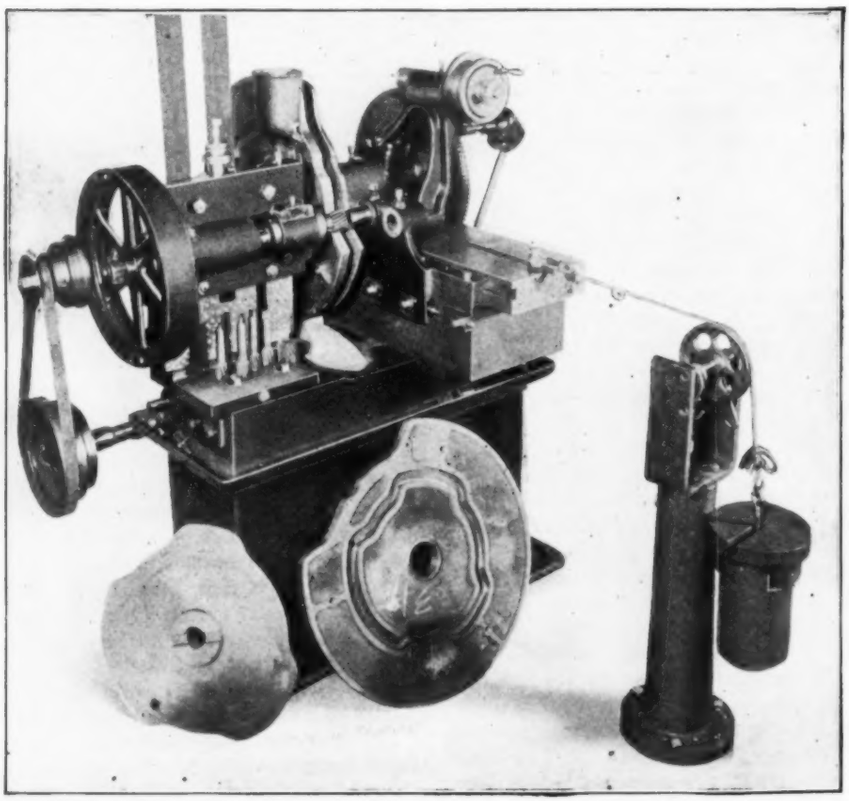


FIG. 1. SPECIALLY DESIGNED CAM CUTTING MACHINE

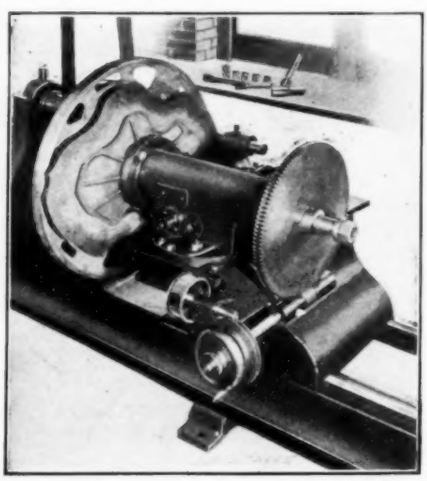


FIG. 2. ANOTHER CAM CUTTER

the post leading to the tackle block and weight bar (one weight is shown) was found necessary on account of heavy duty and does not require the additional amount of weights, as seen in Fig. 1. On the bench are the different size cutters and gages used for cutting the groove in this cam. The groove is 2 inches wide by 1 1/16 inches deep.

The average amount of metal to be removed is about 3/8 or 3/16 inch on both sides of groove, which shows that in order to make a good and accurate job on so large and heavy a cam it is absolutely necessary to have the leader and roll directly in back of cam being cut.

Fig. 3 is a linear cam-cutting attachment (used on a No. 5 Becker Milling Machine) designed and constructed under the supervision of J. M. Wiggin, foreman of the tool department. This cam has a 1-inch groove about 1 inch deep and is about 36 inches long. Three cuts are taken, the same as on all the other cams I have described, two roughing and one finishing, and one with a special tool flooded with oil to give the sides of groove a hard and smooth finish, which is highly desirable.

The capacity of these machines is as follows: The machine in Fig. 1 will cut a cam path 4 inches to center diameter, to 26 inches outside diameter. Fig. 2 will handle a cam path 8 inches to center diameter to 42 inches outside diameter, and Fig. 3 cuts any irregular pathway from 1/4 inch diameter of cutter to 4 inches diameter of cutter and up to 3 feet in length.

Recentering Hollow Square Automobile Transmission Shafts

The F. E. Reed milling machine shown in Fig. 1 has been put to a rather novel use. In the first place it is used as a center-truing machine and later on, when the shafts whose centers it has trued in a soft state are hardened, it is used to test up the amount they have twisted and bent in the hardening process and to assist the straightener in his difficult work.

Fig. 2 shows the machine with one of the square shafts in place. These shafts are turned out of square stock between centers on the lathe. After turning, they are drilled and reamed for two bushings, which are forced into them after they are hardened. It is necessary that the shafts should be true with the hole so while they are soft and before they are finished on the outside they are put on the mandrel mounted in the spindle of the milling machine shown in Fig. 1.

This mandrel is hollow and is fitted at the extreme end with an expanding bushing, which is controlled by the hand wheel at the rear end of the spindle. The square shaft has a bearing at the end near the front bearing of the milling-machine spindle and also at the end on the mandrel on the expanding bushing. Mounted on the table of the machine is a fixture carrying a pointed turning tool secured in a sliding head set at 30 degrees from the center line. The machine is started and a light cut is taken in the center, truing it with the hole in the square shaft.

The pieces are then hardened and after hardening are brought back to the machine where an indicator is substituted for the center turning tool and the shafts are tested and then trued under a press. From the straightening operation the shafts go to the grinding machines, where they are ground on the cylindrical part on Norton and Landis machines and on the square part on special machines built by Mr. Lipe, and which use a large ring wheel. The cylindrical part is ground at an average rate of about 11 per hour, and the square part at a rate of about 50 per day. This method of truing shafts is in use in the shops of the Brown Lipe Gear Company, Syracuse, New York.

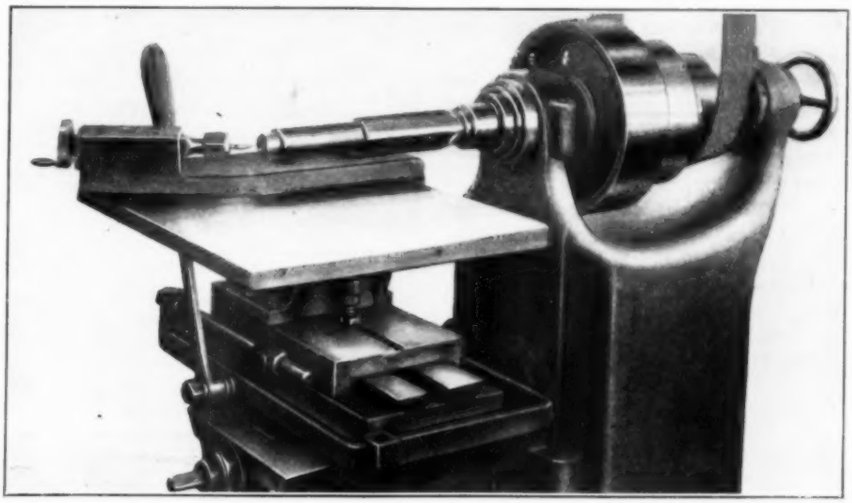


FIG. 2. REED MILLING MACHINE WITH SQUARE SHAFT ON THE ARBOR

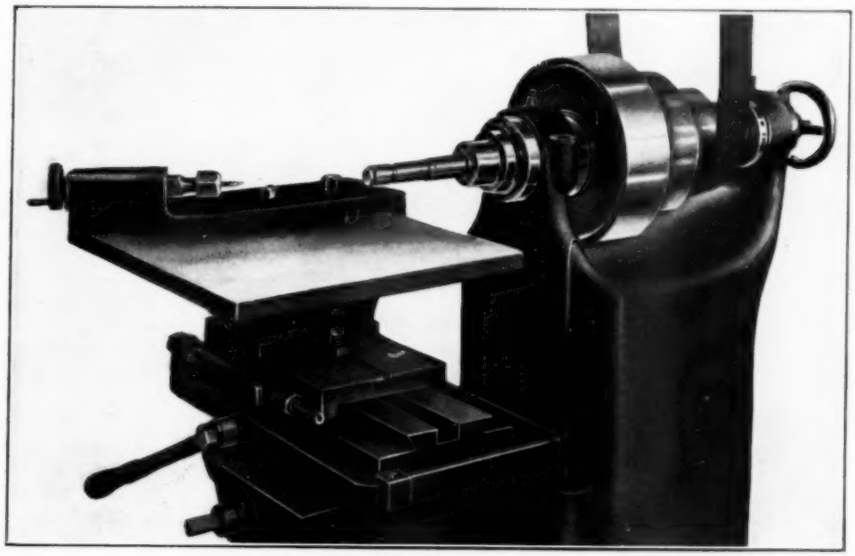


FIG. 1. F. E. REED MILLING MACHINE USED FOR TRUING CENTERS IN SHAFTS

A mixture for preventing machinery from rusting reported to give good results, consists of one ounce of camphor dissolved in one pound of melted lard. Remove the scum and add sufficient fine black lead to it to color. After cleaning the parts smear with this mixture and after 24 hours rub clean with soft linen cloth.

Apprenticeship System of the Fore River Shipbuilding Co.

A Plan Which Has Made Good in a Ship Building Yard

By J. E. Neary *

Five years ago the Fore River Shipbuilding Company, Quincy, Mass., decided to reorganize its apprenticeship system and place it on a strong footing. An instructor was appointed to interview the apprentices each day at their work and help them over the rough places. A systematic record of their progress was adopted, as shown by the various forms which are illustrated herewith. During the first winter all apprentices were required to attend an evening school at the local Y. M. C. A. and the instruction was made to pertain to the work relating to the various trades; but although a great amount of good work was accomplished, yet the management decided that a boy's brain is somewhat deadened after a day's work, so it was decided to open a schoo' room for the apprentices in the shipyard.

At present there are 62 machinist apprentices in the shop and 8 in a separate department, known as outside machinists; 31 boys are learning the joiner trade, 5 are to be patternmakers, 3 ship carpenters, 7 blacksmiths, 7 plumbers, 5 coppersmiths, 7 electricians, 2 shipfitters, 6 chippers and calkers, 6 sheet-iron workers; making 149 apprentices learning 12 different trades.

Requirements of Admission

Applicants for apprenticeships, to become indentured, must not be less than 16 years of age and they are not desired when more than 17 years of age, but such may be accepted by the company at its discretion. They must be physically sound, of good moral character and have received an education at least equivalent to that required for graduation from the public grammar schools; however, all other requirements being equal, the boy with a high-school education is generally preferred. There are at present nearly 300 boys on the waiting lists, in the various trades.

The applicant is put on probation for the first 48 days of his service and if, upon the expiration of this term, he has proved satisfactory to the company, he then executes, together with his parent or guardian, an agreement of apprenticeship with the company. The full term of service in apprenticeship is determined by the requirements of the trade selected and the previous experience of the applicant. It is generally four complete years, with certain intervening days in each year to be taken for the purpose of recreation at such times as the company may approve. Apprentices are paid 8 cents an hour for the first year, 10 cents the second year, 12½ cents the third year, and 15 cents the fourth year. As soon as the agreement of apprenticeship is signed $100 is deposited by the company with the treasurer. This is known as the apprentice's bonus account. He is allowed to buy tools, technical magazines, books, etc., and charge them to his bonus, the balance to be paid him at the time he completes his apprenticeship.

The company has a regular school room in one of the buildings at the shipyard equipped with desks, blackboards, etc. All the first-year apprentices attend class four hours each week during morning hours and are paid for their time in the school room just as though they were working in the shops.

Efficiency record of John Smith

Apprentice Machinist No. 1991 in M Department

Residing at 16 State St. Parent or Guardian Frank Smith

Quincy, Mass. Residing at 1460 Washington St.

Previous experience or schooling 3 Yr. High School. Boston.

Age at beginning of Apprenticeship 16 years. Apprentice agreement signed Oct. 7 1907.

SCHOOL REPORT. Class 1908. 1909. Arithmetic 88% 92%
Geometry 85% 1st Term. 89% 2d Term.
Drawing 75% 84%

1st Year began Aug 7 1907	First Quarter	Second Quarter	Third Quarter	Fourth Quarter
Timekeeping	60	80	100	60
Accuracy	60	40	60	60
Speed	40	40	60	60
Neatness	80	80	80	60
Conduct	100	80	80	80
Avg. Percentage	68	64	76	64
Hours Absent	30	45	45	89

3d Year began Aug. 15, 1909	First Quarter	Second Quarter	Third Quarter	Fourth Quarter
Timekeeping	60			
Accuracy	60			
Speed	60			
Neatness	80			
Conduct	80			
Total Percentage	68			
Hours Absent	32			

1st Year	Working on	Working with
First Quarter	Helper in office Bolt Machine	Alone Alone
Second Quarter	Miller	Alone
Third Quarter	Drill	Alone
Fourth Quarter	Bench Work	M 560

3d Year	Working on	Working with
First Quarter	Lathe	Alone
Second Quarter		
Third Quarter		
Fourth Quarter		

2d Year began Aug 2 1908	First Quarter	Second Quarter	Third Quarter	Fourth Quarter
Timekeeping	80	100	60	40
Accuracy	60	60	60	60
Speed	40	60	40	60
Neatness	80	60	80	80
Conduct	80	80	60	80
Avg. Percentage	68	72	60	64
Hours Absent	21	21	58	146

4th Year began	First Quarter	Second Quarter	Third Quarter	Fourth Quarter
Timekeeping				
Accuracy				
Speed				
Neatness				
Conduct				
Avg. Percentage				
Hours Absent				

3d Year	Working on	Working with
First Quarter	Lathe Help on Drills	M 518
Second Quarter	Help on Shaft Lathe	M 582
Third Quarter	Help on Slotter	M 312
Fourth Quarter	Slotter Planer	Alone Alone

4th Year	Working on	Working with
First Quarter		
Second Quarter		
Third Quarter		
Fourth Quarter		

American Machinist

Specimen Efficiency Record of an Apprentice

*Instructor of apprentices.

Instruction

They start with shop arithmetic, all the examples applying directly to their work in the shops, and gradually studying more difficult shop problems, which involve practical geometry and strength of materials. The following is a typical example for a machinist apprentice:

A piece of steel shafting 10 feet 3 inches long is rough machined to a diameter of 11¼ inches. When finished to a diameter of 10½ inches and with a 1-inch diameter hole running through its entire length, how much has it been reduced in weight?

In drawing the apprentice is first taught to make free-hand sketches, with dimensions, then mechanical drawings of the various parts he is working on in the shops, and afterward taught to pick the various parts off of blueprints. In this way he soon becomes accustomed to drawings and learns to read them understandingly. The apprentices are taken in the schoolroom in small classes, averaging about 15 to the class, thus enabling the instructor to give them individual attention.

The company selects for the hull, engineering, and electrical drafting rooms each year, apprentices who show sufficient ability in the apprentice school in mechanical drawing and wish to become draftsmen; it also selects for temporary service in its drafting rooms, apprentices who have showed ability and wish to gain some experience in drawing in addition to the work of their trade.

Each department has a schedule which is carried out as far as practicable and wherever a step has to be dropped another of equal value is substituted. The

Apprentice John Smith No. 1991 M. Dept.

Apprenticeship began Aug. 7 1907. Probation finished, Papers signed, Oct. 7 1907.

	1st Year.		2d Year.		3d Year.		4th Year.	
CLASS OF WORK.	Began.	Finished.	Began.	Finished.	Began.	Finished.	Began.	Finished.
Assembling								
Bench Work	Apr. 24'08	July 24'08						
Bolt Machine	Sept. 2'07	Oct. 31'07						
Boring Mill, Hor.								
Boring Mill, Vert.								
Bucket Machine								
Drill	Feb. 17'08	Apr. 24'08						
Drills, Multiple								
Erecting Work								
Gear Cutter								
Grinder								
Helper, Assembling								
" Boring Mill								
" Drills			July 24'08	Nov. 27'08				
" Erecting								
" Installing								
" Lathes			Nov. 28'08	Jan. 30'09				
" Laying out								
" Planers								
" Slotters			Jan. 30'09	Feb. 27'09				
Lathe			July 31'09	———		Feb. 5'10		
Laying out								
Miller	Nov. 1'07	Feb. 15'08						
Planer			Apr. 24'08	July 31'09				
Setting up								
Shaper								
Slotter			Feb. 27'08	Apr. 24'08				
Tool Making, Special								
Turbine Work, Special						Feb. 5'10		
Drafting Room, Special								
Engine Room, Special								
Help in Office	Aug. 7'07	Aug. 31'07						

American Machinist

Specimen Progress Record of an Apprentice

Apprentice Chippers at Work on Turret of North Dakota

following arrangement is for machinist apprentices:

During his first two months of probation, the apprentice is required to serve as a messenger in office work, or in helping at any miscellaneous jobs of the department so that he may become familiar with the work in the shops, the yard and on the ships. After his probation is satisfactorily passed the apprentice is kept steadily at his trade and the foreman regularly shifts him to different parts of the work, to give him the necessary training and experience.

During the first six months he is given work on the bolt machines, milling machines and other small tools. He immediately starts in on productive work, on any of the machines, there being no special machines set aside for apprentices. During the last six months of his first year, he is given turbine work, general bench work, chipping, filing and ordinary finishing. During the first six months of his second year he is generally placed with different machinists, at the direction of the foreman, on various tools such as drills, planers, grinders, big

lathes and boring mills; during the last six months he is given work on the slotters, shapers, planers, small boring mills, drills and lathes until it can be determined to which machine the apprentice is best adapted.

In his third and fourth years he is placed at whatever tool he has shown himself to be best adapted, in the discretion of the foreman, and is given work that will develop his special ability. As alternating courses in the third and fourth years, apprentices properly adapted for them, may specialize in laying out, setting up, fitting and bench work; or in finishing work in the tool room; or in erecting and installing main engines and auxiliary machinery in the shop or on the ships.

Social Features

The boys are banded together socially by athletics. They have their own baseball team, which won the local championship last season, as well as a fast track team, and during winter months they play basket ball. They had their first banquet this winter and it was a great success. Among the guests were the local mayor, officials of the company, and several prominent industrial educators. The company allows the apprentices the use of the schoolroom as a club room during the noon hour and boys enjoy reading the periodicals which are on file there.

Over 50 boys have completed their apprenticeship under the new regime and they are all getting at least journeymen wages and many are holding positions as draftsmen, leading men, etc. About 75 per cent. of the alumni are still with the company.

Employers' Liability Insurance*

By Miles M. Dawson

There are three separate lines of inquiry which are of special importance to employers, I take it, in discussing what is really to their interest in regard to liability insurance. The first is how much money does it cost, and how may this expenditure be reduced if it is possible to reduce it? The second is, how may the hap-hazard conditions which sometimes lead to a great waste of material, as well as impairment and destruction of human life, be reduced so as to economize directly in the cost of production? The third is what effect does one or another system have upon the workmen themselves with particular reference to their efficiency? I am taking the liberty of dealing with these in reverse order.

It will perhaps surprise my hearers to learn the following: A very prominent manufacturer of Germany after a recent visit to the United States, and just before his departure, made substantially the following statement, "I was here once before, some 15 years ago. At that time I felt that German manufacturers had much to learn from America, and particularly about the management of their factories. Now I do not find that there is much to learn, while I know that American manufacturers have very much to learn from us." The chief thing which close observers of the conditions in the two countries would immediately point to, as the determining point of difference between American methods and German methods is the development of the efficiency of the workmen themselves. Whereas, no more than twenty-five years ago, German workmen were not regarded as efficient either from the standpoint of quantity or quality of product as the workmen of several other countries, and particularly of Great Britain and the United States, precisely the contrary is now pretty generally acknowledged to be the case. It will interest my hearers, I am sure, to know that, when I was abroad in 1908 to study employers' liability and employers' liability insurance, as well as other schemes for insuring workmen, throughout Europe, I found that the superior efficiency of German workmen on the whole was very largely ascribed by everybody to the system of employers' liability insurance, which had been introduced in Germany. This was accounted for as follows:

Under the system which obtained there before, and which was about the same as is this country at present, the life of the workmen in many occupations, was a gamble, in which the fate of their wives and children and of others who might be dependent upon them was at stake. They saw the severest misfortunes come to families, amounting to complete demoralization, without any fault on the part of the man himself. In consequence, their entire attitude toward life was that of one who takes chances, and not of one who finds that, if he does his full share of honest productive labor, there is an assurance of good conditions for himself and for his family. On the other hand, at the present time, precisely the contrary conditions exist, viz: That the only way in which those dependent upon him can be involved in absolutely disastrous misfortune, is for him to become an idler and fall out of the ranks of regularly employed wage-earners. If he is a steady workman and if any misfortune comes to him, a sufficient financial support to keep him and his family from the poorhouse or from depending upon public or private charity, is assured. The effect of this upon his character is said to have been nothing short of marvelous. Other results likewise are pointed to, such as that by reason of the new conditions there is very little expensive litigation, that the cost of getting a dollar to the insured workman or the family of a workman who is killed, is about 10c. or 12c., instead of at least another dollar as in our own country, that the burden on the manufacturers is evenly and uniformly distributed, and that excessive verdicts are not merely transferred from the shoulders of the individual manufacturer to the entire trade, but also do not exist at all.

German System of Employer's Liability Insurance

The German system of employers' liability insurance deserves very specially to be briefly outlined for the members of the National Metal Trades Association. Unfortunately, the general impression in the United States is that it is a system of state insurance where the State collects premiums from the employers, administers the funds, pays the claims and in general manages the whole affair. The fact is precisely the contrary, that is, that the system is one under which the trades themselves are organized into mutual trade associations such as your own, to which every person or company engaged in that trade is by law required to belong, and which are managed by their own members. The liability to employees is transferred from the individual employer to these trade associations and the amount of liability is absolutely fixed by law and is likewise entirely independent of questions of negligence; so that there is no quarrel over whether the employer is liable or not. The only difference of opinion that arises, is when there is partial disability, the degree of which has to be determined. These trade associations are, as stated, conducted at an expense of about 10 or 12 per cent. and it is generally conceded that their effectiveness, both in the shrewd and careful management of their business and also in bringing about the adoption of safety devices and a reduction in the hazards of industry, far exceeds that of any system which has ever been introduced in any other country.

Under the German system, the amount of liability in event of total disablement is fixed at a certain proportion of the wages and is payable like wages, that is, by weekly payments. In event of partial disability an amount proportionate to the impairment of the earning power is paid. In event of death a pension is paid to the widow during her widowhood, that is, until her death or remarriage, and a pension to each child during its minority, that is, until reaching the age of sixteen. These pensions in the aggregate must not ex-

*Abstract of an address delivered before the National Metal Trades Association, April 14, 1910.

ceed the amount that the man would have received himself, had he been totally disabled.

This system I personally regard as the most satisfactory one for employers' liability insurance that is to be found in any country. It could be introduced, precisely as it is in Germany, only by means of legislation. If there were such legislation, as our National Constitution stands at present, it would apply only to individual States and would take effect in those States, only when adopted by their respective legislatures.

The further question remains, what can be done under our existing laws by the voluntary act of individual employers or trade associations of employers and what method of insurance is wisest for them?

Four Available Methods

There are but four other methods available. One of these is to arrange, by means of a workman's collective policy, issued by an employers' liability insurance company for protection of the workmen against the hazards of accident, without regard to liability, the employer contributing toward the premium and either thereby becoming entitled to be protected against his liability or else paying a somewhat reduced premium for protection against such liability. Theoretically, this kind of insurance is much more desirable from many standpoints than employers' liability insurance alone; but in practice it has not found favor.

The most recent form of insurance of this general nature is known as "employers' compensation policy," under which the employer is authorized to compensate his employees for injuries sustained, without regard to liability, to certain specified amounts.

The third method is a system of insurance, paid for by monthly premiums and furnishing sick benefits as well as accident benefits, the employees either contributing the whole, or the employer making such contributions thereto as he may desire.

The fourth method is by a mutual insurance fund created by and among the employees and supported by their contributions, either assisted by contributions on the part of the employer or entirely independent of such contributions.

None of the other methods approaches the fourth method, either in economy or in avoiding litigation. Their relative want of economy results likewise in there being materially smaller benefits for the same amount of contribution. Whether that contribution be solely by the employees or in part by the employees and in part by the employer, under mutual schemes to which employees contribute and especially of employers also contribute, there is usually a reasonably complete provision made for the maintenance of the disabled employee and his family; and, since this provision is immediately available, there is usually no question raised as to accepting it and going forward without calling in the lawyers or the courts. The expenses should rarely, if ever, exceed 10 per cent, of the amount paid out in benefits; whereas it is not probable that any of the others can be operated at an expense of less than from one-third to one-half of the total amount paid, in other words from fifty cents to one dollar for each dollar of benefit.

Advantages of Co-operation Among Members of the Association

There would be obvious advantages if the members of the Metal Trades Association could and would combine to cover their liability and to provide for their injured workmen and the families of workmen who are killed, through their mutual trades association or a subsidiary association connected with it; and, if the same were established upon a sound insurance and actuarial basis, unquestionably a larger measure of relief to the injured and the families of the dead could be given without an increase in expenditure. Indeed, the benefit would be increased nearly, if not quite, 50 per cent. as compared with the cost of employers' liability insurance. Yet these benefits could be paid without an increase of cost to the manufacturers, by permitting and encouraaging, or best of all requiring, employees to contribute in order both that bigger benefits might be paid and also that all sicknesses and disabilities might be covered without regard to negligence, and also without regard to whether the same are incurred while the workmen are at work or when they are off the work.

The Machine Rate Plan of Cost Keeping *By Frederic G. Coburn*

These remarks will treat of only one phase of the plan of cost keeping, devised and advocated by A. Hamilton Church. Probably most of the readers of the American Machinist know that this plan is a combination of the old machine-rate plan, highly developed, and the hourly-burden plan, much simplified. It provides a record of the cost of operation of the various production centers and requires the keeping of output records of these production centers, a production center being a machine tool, a bench, or even an area in the shop in which productive work is done. That is, it shows for each production center a plain debit and credit account.

This account can be made so useful by the engineer, aside from its part in the determination by the accountant of the resultant cost of work, that I think it worthy of particular notice.

Any shop superintendent frequently has occasion to ask himself questions like these:

Why is this machine so busy and that one so idle?

Are these machines as busy as they seem to be?

Are they busy on the right class of work?

Should this job go to a shaper or a milling machine?

This account will answer just such questions. Moreover, it will tell us of the need of new tools either for additions or replacements, and will tell us the kind of tool and the make which will pay best under the conditions of our own shop. It will show us in the case of duplicating work who are the good operators, and how processes may be developed, simplified or improved. It will teach us how to equip our machines and even how to group them. It will give us a line on patent attachments, etc., and show up "talking points." It will be of immeasurable value to the planner and the weight fixer. A test of a new tool or appliance, with these accounts in general use in the shop, would really tell us something.

In a recent issue of the *Saturday Evening Post* there was an article on successful dairy farming and it told of farmers who transformed deficits into surpluses by getting acquainted with the production centers of their plants, the cows. They opened accounts against them and got rid of those which did not pay, and they found many surprising things just as by the adoption of a similar plan in our plants we will find out many surprising things about tools which we have sworn by for so long.

In advocating cost-keeping systems, their devisors lay stress on the point that we must figure our costs closely and accurately in order to exploit those lines which will pay. But let us also lay stress on the point that we must know the costs of our production centers in order that we may exploit, in our shops, those machines and those methods which will pay. Undoubtedly, there are many shops, large and small, in this land where the questions raised above could not be definitely answered on account of lack of data, and these questions must have definite answers if such shops are to survive.

The production of steel railroad ties and fasteners in Germany increased from 123,000 tons in 1888 and 356,000 tons in 1906 to 494,000 tons in 1907.

Interesting Fixtures Used in a Machine Tool Shop

Methods Which Will Save Time and Can Be Used in Any Shop

Editorial Correspondence

When one recalls the very crude method of drilling the holes in the planer tables, the comparatively inexpensive machine shown in Fig. 1 is seen to be an extremely easy and economical way out of the difficulty. Instead of laying out the hole either from scribed lines or otherwise, and drilling them under a radial or other drilling machine, the Whitcomb-Blaisdell Company has fitted up an old planer with a four-spindle drilling head made by the Moline Tool Company, Moline, Ill. Its operation is so simple that it requires no further explanation except to point out that the table of the planer which is being used in this way has holes drilled at the correct distance apart and is spaced each time by the very simple indexing lever on the left-hand housing. It is needless to say that a large amount of time is saved in this way on each planer table to be drilled.

Double Boring Fixture

Fig. 2 shows an interesting fixture used to bore the housing or case of the quick-change speed mechanism used on the Whitcomb-Blaisdell lathes. The gear case is shown in position on the fixture, which answers for different sizes and also shows how the fixture is mounted on the drilling-machine table. The gear box is readily located by dowel pins and stops, and quickly clamped into position by the handles shown. Both boring bars are driven at once by the special boring head which has been made to slip over the quill of the drill spindle. Each bar is driven from a central gear which has a taper shank projecting from it and fits the taper of the drilling spindle. This makes a very substantial driving fixture for the two boring bars and allows both holes to be bored at once which means considerable saving of time.

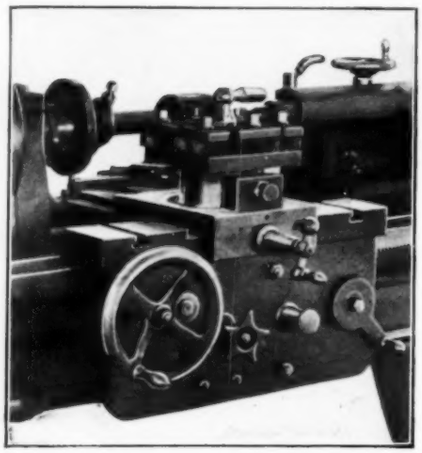


Fig. 3. Turret Tool Post for Lathe

Square Turret Tool Post

Fig. 3 shows the way in which a large amount of such work as gear blanks is handled in this shop. A special tool post is mounted on an engine-lathe carriage, the main feature of the tool post being the large square plate carrying tools at each corner in the way shown. A simple strap and cap screw allows two tools to be firmly clamped in place, the desired distance apart, so that one pair of tools may be set for roughing and the other for finishing. In this way the gear blanks are roughed and finish turned on the outside, and are also turned on both sides at once by the use of straddle tools. The time made compares very favorably with some special machine work on pieces of this kind. For a simple tool post this

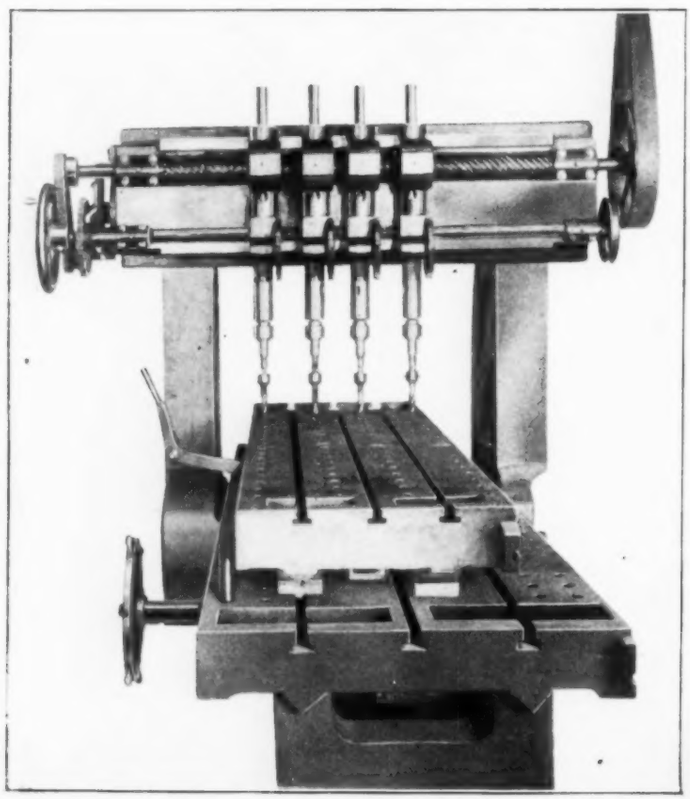


Fig. 1. Drilling a Planer Table

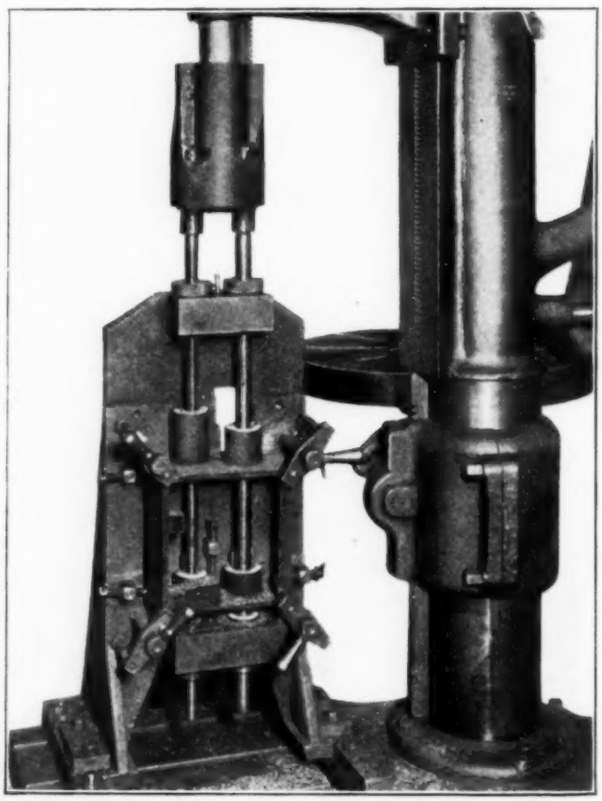


Fig. 2. Double Boring Bar

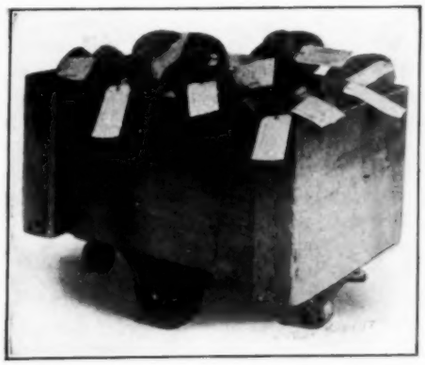


FIG. 4. TRUCK BOX FOR CASTINGS

has about as many possibilities as any we have seen.

HANDLING CASTINGS AND WORK

The Whitcomb-Blaisdell Company has a very good system of handling castings direct from the foundry. Instead of having the foundry dump them into a wagon and having these pieces again dumped onto the shop floor to be handled and sorted, the foundry delivers the castings in truck boxes as shown in Fig. 4. One piece of each lot in the box is tagged as shown, which gives the number of pieces in the lot and so far as possible, only complete lots are put in each box. The case shown indicates that this is a number of small lots which have just been received from the foundry and the whole truck goes directly to the department where it is to be machined, without further handling.

As a continuation of this method they have also had a number of steel work trucks built as shown in Fig. 5. These are made from tank steel and have the ends turned up as shown. One of these trucks is placed by each machine so that the operator can lay his finished work on these instead of piling it on the floor and requiring another handling to move it to the finished stock room or to the next department, as the case may be.

FIG. 5. STEEL TRUCK FOR FINISHED WORK

Those who have gone into the cost of handling material to any extent will appreciate the saving which is effected in this way, and while it is by no means an unheard of proposition it is all too uncommon in many shops.

Buying Some Machine Tools

By Entropy

We have been having a great time getting a miller; that is, we will call it a miller because that is what it isn't. We ordered it at $175 from a local dealer. He sent in the order and in the course of two weeks he came back and said that the price was $225. Of course, we did not like to pay the extra $50, so we chased up another dealer who said he had one in stock in New York, bought it before the price went up, would let us have it for $165. We ordered it.

Two weeks more and he came around with a long face and said he found they had sold it and they would have to get the machine from the builders and it would cost us $225. We decided not to order it at that price and looked up two or three other machines. After spending two weeks more, we decided that our first choice was best, and went to the first dealer and gave him the order for delivery in three weeks.

In two weeks more he came around and said it would take them five. We told him to be sure and get it in five and gave him a cigar (one that he had given us a few weeks before). Two weeks after the promised delivery we called him up on the 'phone. "Oh, yes! Why they only promised delivery in seven weeks." Come to find out he only *thought* the manufacturer could deliver in five weeks; they *wrote* seven. Two weeks more and they were very busy; had every man in the shop on our machine. Two more weeks and they had a fire (under the boiler?). Two more and they had not been able to get their insurance adjusted. Two more, we forgot to write. Two more, the street-railway men went on a strike and their employees couldn't ride to work. Two more and they would ship the middle of next week. Two more and they would ship the next day. Two more and we countermanded the order. Having gotten where we needed the machine, we telegraphed one of the other makers saying that we would order at 10 per cent. less than their regular price provided they could make prompt delivery. They wired back: "Offer accepted; machine shipped," and we had it at work inside of 48 hours.

Judging by my own experience in building machinery, there is something wrong when a concern takes 23 weeks on a seven-weeks' delivery. Every shop knows how much it can turn out in a month on the average, and with 10 times that amount in orders on its books ought not to take orders for delivery in three months. Or it may happen that a shop could make delivery on time as promised, but it plays favorites and later orders are given preference. This is only a little worse than the other way.

Recently it has become the favorite thing among lawyers about here, if any one is injured by a wealthy corporation to not only sue for damages for the injured person, but also for all the friends and possible heirs at law to sue for loss of services of their dear friend. I am looking to see someone sue a machinery builder for loss of the use of a machine during the time elapsing between the promised delivery and the actual.

FASHIONS IN MACHINE TOOLS

The fashions in machine tools are not changing so rapidly as those in bonnets or automobiles, but they have their changes just the same. To be sure, the machines that we buy are not so very different today from what they were 10 years ago, but those that are advertised are very different. You would think that some of these machines that are covered with automatic stops and gear feeds and beltless heads and all kinds of new style beds that were invented and re-invented years ago would have relegated the older, simpler belt-driven, cone-driven and belt-fed machinery far to the rear, but as a fact, the more new-fangled things are invented the more old ones are used.

I see that people are beginning to talk about semispecial tools. One man builds a stud lathe. To be sure, these stud lathes are older than I am, but they are beginning to be advertised. It does seem a little odd to lock up a few hundred dollars in features in a lathe which are only used on special jobs, but it seems to be the demand that makes it necessary.

Take a radial drill. I put one on the market once. First I built one. Just a plain, straightforward tool that would do the work and lots of it. Then I called on all my dealers and got their opinions. One wanted an automatic stop, one a device to lock the arm. Another a gear feed, another a splined shaft and bevel-gear drive, another a tapping attachment, and so on. Each one said his improvement would cost about $1.30 and would make it sell for $25 more.

I put all these things in except the tapping attachment, and built a half a dozen. The half dozen made up in a lot, with jigs and all, each cost us more

than the first machine made up in simonpure, machine-shop fashion. These little extras, talking points mostly, are an expensive luxury and only an expression of the cycle of fashions. It is a matter of whether you will charge $100 for a machine and then charge the customer $25 for accessories that he must have, or charge him $150 and furnish him with twice the number of accessories that he needs. Truth is, that when I am buying I like to have the whole thing spread out before me and buy what I want and let the rest go. I never like to go into a restaurant and order lamb chops and see thirteen little side dishes standing around that I don't like but have to pay for.

Buyers of Machine Tools

That brings up the question of the average mechanical intelligence of the buyers of machine tools. Modern advertising is either educational or else it is based on an assumption that the average buyer has more mechanical sense than I suspect him of. It is curious to see how many successful concerns leave their buying to men whose knowledge of machine tools is confined to the size of the bills. And it is likewise surprising how many men there are, who have risen from the bench and lathe to be heads of their own shops, who do not know anything about any tool except the one that they have run most.

Take the average jobbing shop. How many workmen could intelligently buy a screw machine or a surface grinder? In a shop running on jigs and dies, how many could pick out the best 48-inch planer? And yet these men use and pick out these tools, not because they want to but because they must make a bluff at it. How are these men to know what to pay for a tool? When you can buy a given size engine lathe for anywhere from $250 to $750, it is hard to tell which make to get. Machine tools are not sold on a basis of cost plus 10 per cent. for profit. Not a bit of it. The most expensive ones are sold on a basis of cost plus 50 per cent. and the least expensive on cost minus 10 per cent. If one's idea of good business consists in buying something on which the maker has lost money, let him buy the lowest price tool!

The way some of these people have of setting their price is to say: "My lathe is as good as Blank's and a blame sight better than Dash's and almost as good as Hyphen's, so I will find out what they get, average it, and set my price about there." The final price depends largely on the size of his bump of conceit. If he thinks his lathe is the best ever, even if it is not so very good, he will be too proud to drop his price so he will make it good enough to command the price. He will probably carry it off all right for three-fourths of all the lathes are used on work where inaccuracies in the tool would not be noticed from one year's end to another.

Why Not Guarantee Lathe Output?

If you want to buy an engine you are told not only that it is new and improved and has the largest wrist pin and the least clearance of any engine on the market, but that it will run on 24.3 pounds of water per horsepower-hour. Did anyone ever hear of an engine lathe being guaranteed to do a given amount of anything? Automatic screw-machine people will tell you just how many pieces of any kind you can do in an hour before you place your order, but ask an engine-lathe man and he will say: "I don't know just how many it will do, but it do more than any other lathe *you* ever saw. Why, my lathe has a tail spindle 1/16 of an inch bigger than any other on the market, and you can cut more different threads on it. Why, I give you two more change gears," etc., etc.; but you never know how many crosshead pins you can turn on it until you try and find out yourself.

It certainly seems as if some rational method might be devised for testing machine tools not only for accuracy but for output. An 18-inch lathe, then, would turn within so much of straight in so many inches from the face plate, it would square within so much, it would cut threads within such and such a limit of accuracy, and it would also take a certain depth of cut and feed without chatter, on various materials. The result would be a desirable one, lathes would then be built for a class of work, some for roughing, some for finishing, each having high ratings, if different. It would be better than trying to make one lathe suitable for everything from fine tools to hogging stock. The present method is much like trying to raise a breed of horses for trotting on the track and hauling freight alternate days.

Machine Tool Calculation for Drills*

By Charles Robbins

The power required in drilling operations can be expressed as a constant times the cubic inches of metal removed per minute. The conditions are, however, more complicated than in the lathe tool, since the friction of the drill and the chips on the sides of the hole increase the power requirement as the drill enters the metal. This is especially true when cast iron is drilled, as chips have a jamming action. The variable cutting speed at the cutting edge of the drill, from zero at the center to the peripheral speed of the drill, also causes a jamming action and tends to increase the power per cubic inch per minute over that required to remove the same amount of metal by means of the lathe tool type. With drills generally employed, the value per horsepower per cubic inch of metal removed per minute is about double that required by ordinary lathe tools.

The chart has full instructions for determining the cubic inches of metal removed with drills. The constants for determining the power required are about double those for lathe tools.

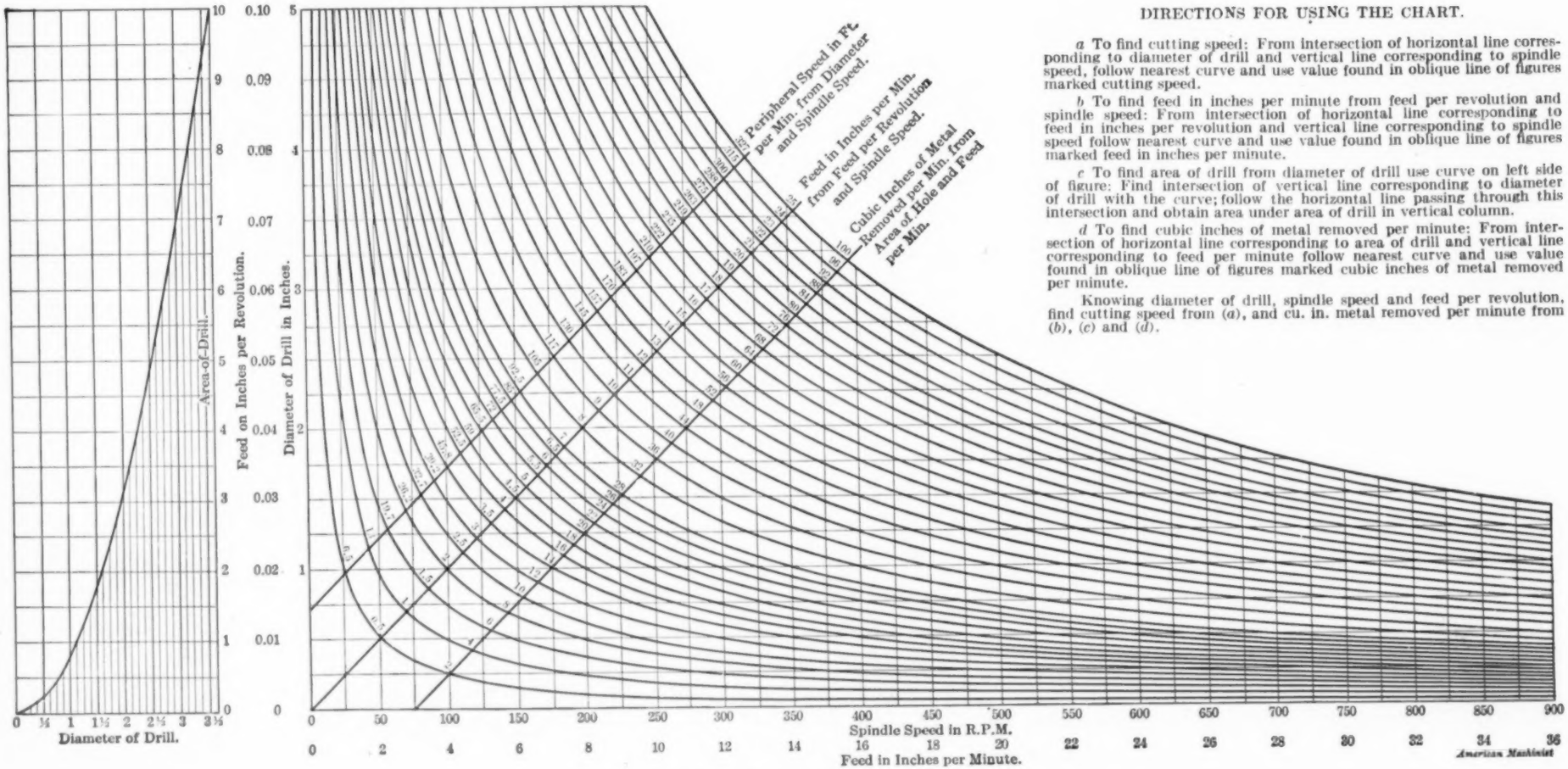
Example: Size of drill = 2 inches diameter; feed per minute = 2.5 inches; speed of drill = 150 revolutions per minute; metal drilled; cast iron.

The peripheral or maximum cutting speed of the drill is found as follows: (Rule *a*): The horizontal line corresponding to a diameter of 2 inches intersects the vertical line corresponding to 150 revolutions per minute on the curve corresponding to a cutting speed of 77.5 feet per minute. The area of the 2-inch drill (rule *c*) is 3 square inches. This area at a feed of 2.5 inches per minute corresponds to removing 7 cubic inches per minute (rule *d*). For cast iron the horsepower per cubic inch per minute is about 0.8, twice that for lathe tools, hence the power required to drive the drill in this case is $0.8 \times 7 = 5.6$ horsepower, which agrees closely with an actual test. For mild steel the power required is $1.2 \times 7 = 8.4$ horsepower. In drilling a hole of this size the friction of the chips does not increase the power materially as the depth of the hole increases, since there is sufficient space for the drill to free itself of chips.

*Abstract from *Journal* of American Society of Mechanical Engineers.

Keep the Starting Crank Clean

In starting a gasolene engine with a crank which slips over the end of the shaft, take particular pains to see that both the crank and the shaft are clean and free from every particle of gritty substance. Should there be any sand or other gritty substance on the shaft or inside the crank, the latter is liable to become wedged fast to the shaft so that the ratchet clutch will not release it and in revolving suddenly, with the great speed of the newly started engine, it is almost certain to break the wrist of the man who did the cranking. The safest form of crank is made like a hose-coupling spanner, to fit around a portion of the shaft without the shaft passing through the crank. Then, when the engine gets an explosion, the "spanner-crank" simply falls off the shaft and there is no danger of catching.


Area of Drill.
Diameter of Drill.
Feed on Inches per Revolution.
Diameter of Drill in Inches.
Peripheral Speed in Ft. per Min. from Diameter and Spindle Speed.
Feed in Inches per Min. from Feed per Revolution and Spindle Speed.
Cubic Inches of Metal Removed per Min. from Area of Hole and Feed per Min.
Spindle Speed in R.P.M.
Feed in Inches per Minute.
American Machinist

MACHINE TOOL CALCULATOR FOR DRILLS

DIRECTIONS FOR USING THE CHART.

a To find cutting speed: From intersection of horizontal line corresponding to diameter of drill and vertical line corresponding to spindle speed, follow nearest curve and use value found in oblique line of figures marked cutting speed.

b To find feed in inches per minute from feed per revolution and spindle speed: From intersection of horizontal line corresponding to feed in inches per revolution and vertical line corresponding to spindle speed follow nearest curve and use value found in oblique line of figures marked feed in inches per minute.

c To find area of drill from diameter of drill use curve on left side of figure: Find intersection of vertical line corresponding to diameter of drill with the curve; follow the horizontal line passing through this intersection and obtain area under area of drill in vertical column.

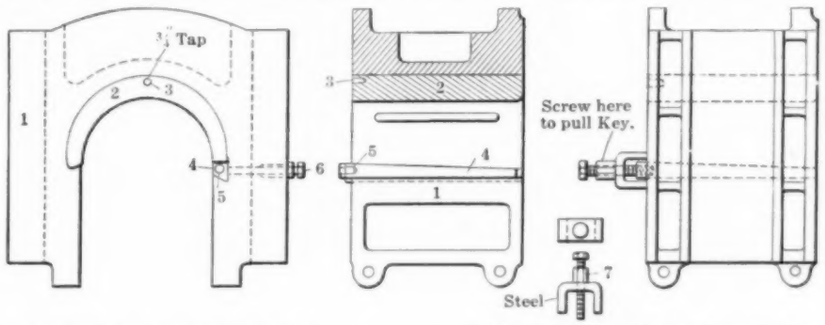
d To find cubic inches of metal removed per minute: From intersection of horizontal line corresponding to area of drill and vertical line corresponding to feed per minute follow nearest curve and use value found in oblique line of figures marked cubic inches of metal removed per minute.

Knowing diameter of drill, spindle speed and feed per revolution, find cutting speed from (*a*), and cu. in. metal removed per minute from (*b*), (*c*) and (*d*).

Economy of Removable Driving Box Brasses *By W. J. Shadle* *

I inclose prints of a removable driving-box brass and fixtures that were designed by shop foreman Charles Markel and have been successfully tried out by the Chicago & North Western Railway. They have passed the experimental stage and are of interest. These three devices are protected by patents in Mr. Markel's name.

The illustrations show removable driving-box brass and details as applied to 9½x12-inch axle. The original trial brass was applied to right-front box on Atlantic type engine 9 by 12-inch journal, 20 by 26-inch cylinder. This engine is in heavy, fast, passenger service on a 202 mile division. The brass in this engine was applied April 9, 1906. This brass is still in service, has never been loose, and up to February 1, 1910, had made 261,049 miles with no labor or material cost since its application. The other three pressed-in brasses on this engine have been renewed twice during this time on account of being loose in the boxes and large on journals. The Chicago & North Western Railway has ten heavy freight and passenger engines equipped complete with these brasses since 1906 and we have renewed these brasses at different times without dismantling any part of the engines except taking down the cellar or two eccentrics, if the main box.



1 Driving Box, (Cast Steel preferred.)
2 Driving Box Brass, (Turned 1/32 smaller than Box.)
3 ¾" Tapped Hole to pull Brass out.
4 Key to tighten Brass (Mach. Steel)
5 7/8"-12 Thrd. Tapped Hole to draw Key by.
6 7/8"-9 Thrd. Set Screw to hold Key.
7 Device for Drawing out Key 4.

TO REMOVE BRASS.

Loosen Set Screw 6, draw out Key 4 with Device 7, Screw Bolt into Brass at 3, and pull out Brass by Hand.
1½" Drive on Key produces 40 Ton Pressure on Brass.

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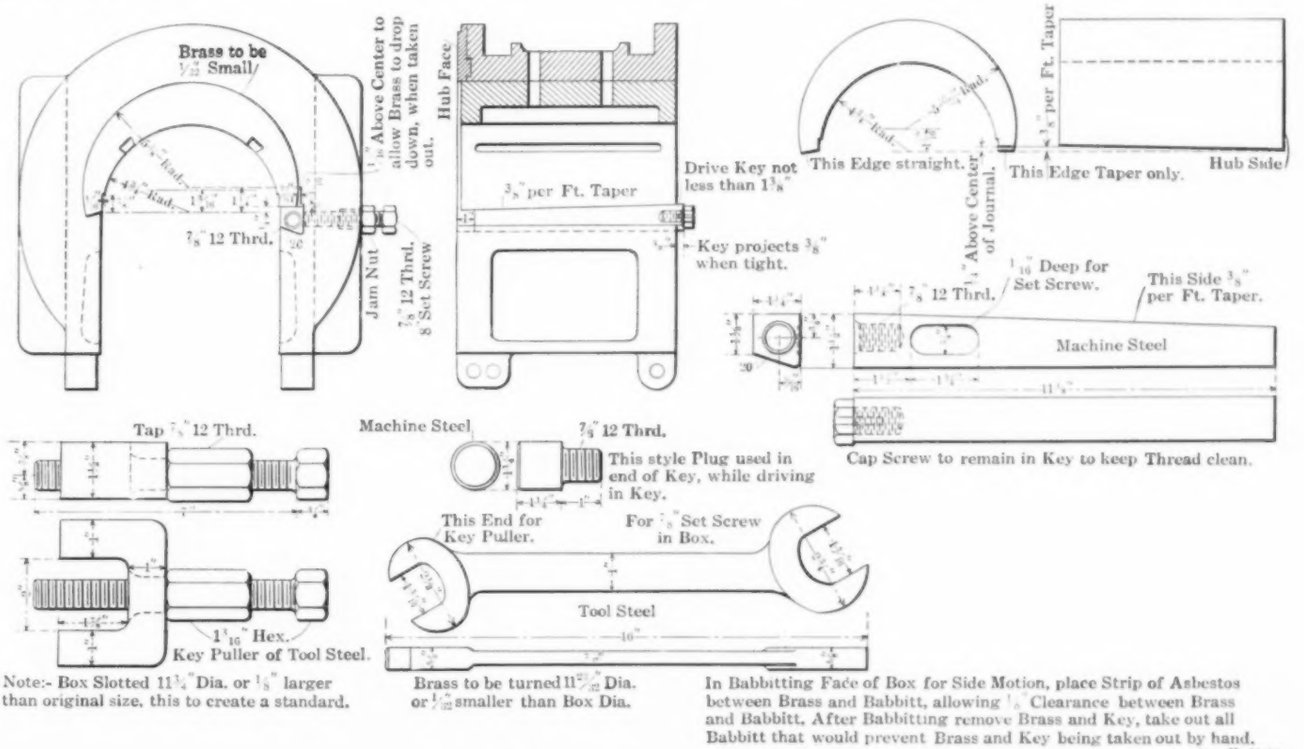
FIG. 1. EXPLANATION OF REMOVABLE DRIVING-BOX BRASS

The following data are from a letter written by me to F. G. Benjamin, master mechanic, November 28, 1908, which gives cost of removable brasses and pressed-in brasses. We have renewed main brasses several times at a total cost of $3.20 and loss of time to engine only six hours. The Chicago & North Western Railway is now having built 20 switch engines and 9 Atlantic type engines which will have this style of brass. It is well liked by all who have anything to do with it, and one of the best features is if the brass should become loose in the box it is only the time consumed in driving the key to make the brass tight in the box. Driving the key 1½ inches will produce 30 tons pressure on the brass. All that is required to remove the brass is to take down cellar-jack box frame journal, pull key with puller shown and remove brass by hand.

The other illustration shows jigs which are very important for the successful use of this brass. The print is very plain and makes all brasses and keys absolute duplicates without any calipering or measuring whatever. Brasses and keys are kept in stock so that all that is necessary for renewals is to get brass from stock, place it in dummy box, drive key and bore to fit axle, after which it is taken from dummy box and placed in

*General foreman, Chicago & North Western Railway, Clinton, Ia.


Brass to be 1/32" Small
Above Center to allow Brass to drop down, when taken out.
Hub Face
3/8" per Ft. Taper
7/8" 12 Thrd.
Jam Nut
7/8" 12 Thrd. 8 Set Screw
Drive Key not less than 1 3/8"
Key projects 3/8" when tight.
This Edge straight.
This Edge Taper only.
Hub Side
Above Center of Journal.
1/16" Deep for Set Screw.
This Side 3/8" per Ft. Taper.
Machine Steel
Cap Screw to remain in Key to keep Thread clean.
Tap 7/8" 12 Thrd.
1 5/16" Hex.
Key Puller of Tool Steel.
Machine Steel
7/8" 12 Thrd.
This style Plug used in end of Key, while driving in Key.
This End for Key Puller.
For 7/8" Set Screw in Box.
Tool Steel

Note:- Box Slotted 11¾" Dia. or ⅛" larger than original size, this to create a standard.

Brass to be turned 11 29/32" Dia. or 1/32" smaller than Box Dia.

In Babbitting Face of Box for Side Motion, place Strip of Asbestos between Brass and Babbitt, allowing ⅛" Clearance between Brass and Babbitt. After Babbitting remove Brass and Key, take out all Babbitt that would prevent Brass and Key being taken out by hand.

American Machinist

FIG. 2. REMOVABLE BRASS 9½x12 JOURNAL

box on engine. Complete set of jigs can be made from second-hand boxes and scrap material for a cost of $15.

This method of applying brasses is very successful in shimming brasses when they become large for journal by simply closing the brass the required amount, place the brass and shim in brass jig and reface both edges, which allows key to be driven the same as originally. The advantage of this shimming is that there is no chance for shim to buckle up as it does in pressed-in brass and shim. These brasses can be reshimmed and used until they are worn to ½ inch thick at crown. The advantages of this brass will be readily seen by all mechanical men.

Here is an interesting record of removable brasses on Atlantic type engine No. 464, since application on July 4, 1906. I personally know that this record is correct and further wish to say that on February 26, 1907, left main brass was renewed while wheels were under the engine at a cost of $3.20 for labor and six hours loss of time to engine. On the basis of $10 a day for a locomotive, I consider that the saving made was $29.25 in favor of removable brasses. After that, in June, 1908, this brass was rebored for axle fit while wheels were under engine at a labor cost of $6.21 and consumed six hours' time. This cost includes lining down one wedge and was a saving of $26.33 in favor of removable brasses. The mileage which these brasses have made to date is very good and as they now look, I believe that they will prove the most economical brass on the Iowa division, as to mileage, expense of labor and loss of time to engine.

Below is the saving of removable brass in comparison with pressed-in brass. Removable brass renewed February 26, 1907, cost as follows. Being main brass, two eccentrics had to be removed from shaft. New brass (cost material), $21.49; to bore to axle fit, $0.19; for labor to apply to box, $3.20; loss of time to engine, 6 hours, $2.46; total cost, $27.34.

Cost to apply standard pressed-in brass is as follows. Engine would have to be dismantled and main wheels dropped, causing an expense of: New brass (cost material), $21.49; labor for all work, $15; loss of time to engine, 2 days, $20; total cost, $56.49.

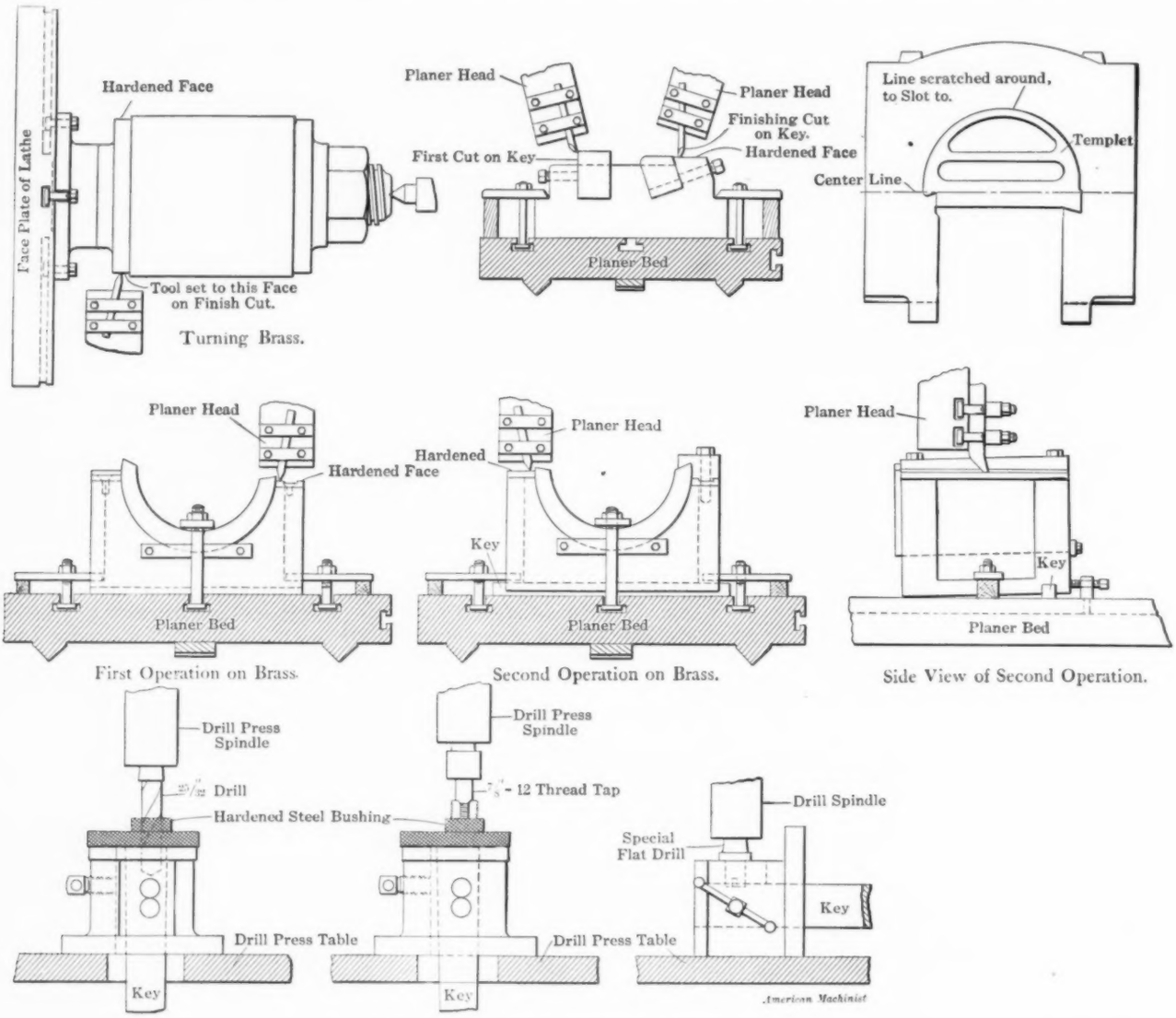


FIG. 3. OPERATIONS ON REMOVABLE DRIVING-BOX BRASS

This brass costs $29.15 more than removable brass.

Removable brass removed, closed and rebored for axle fit, June 29, 1908, cost as follows. It being main brass, two eccentrics had to be removed from shaft: Stove-pipe iron shim, cost, $0.10; labor to apply brass and complete ready for service, $6.21; labor on shim, $0.05; loss on time to engine, 6 hours, $2.46; total cost, $8.82.

If this had been a standard pressed-in brass and it should require closing and reboring for axle fit, it would have cost as follows. Engine would have to be dismantled and wheels dropped: Stove-

pipe iron-shim material, $0.10; labor $0.05; labor to supply and equip engine for service, $15; loss of time to engine, 2 days, $20; total cost, $35.15.

This work cost $26.33 more than the removable brass.

Removable brass, if it becomes loose in a box, costs as follows to make repairs. If front or back brass is loose it can be tightened in one hour; if main brass, it can be tightened in four hours. Average labor cost, $0.92; material, nothing; loss of time to engine, $1.68; total cost, $2.60.

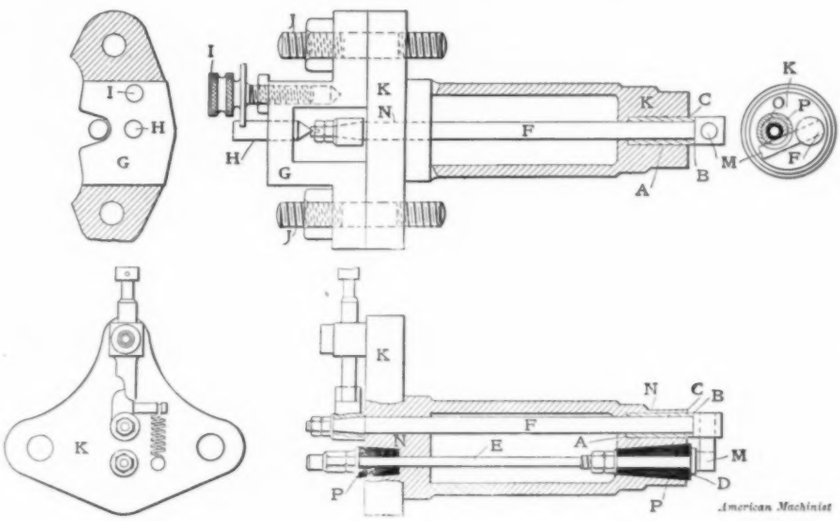
Standard pressed-in brass costs, if it becomes loose in box, as follows, to make repairs, dismantling, dropping wheels, tightening brass in box and assembling all parts ready for service: labor, $15; material, $0.10; loss of time to engine (2) days, $20; total cost, $33.10.

Costs $30.50 more than removable brass. Removable brasses tried out on this engine have given excellent results and I have watched the cost of removable brasses compared with the standard pressed-in brass and the above is the result of same.

Improving Gas Engine Igniter

By J. E. Emerson

The sketch represents the make-and-break ignition mechanism which works in conjunction with a magneto on a gas engine. As supplied by the makers it works well for a short time, the principle being good, but not perfected enough for the wear and tear that mill life demands.



IMPROVEMENTS TO AN IGNITER

The first difficulty is that the high compression in the combustion chamber compresses the shaft *F* against the cast-iron surface of block *K*, just at the moment when shaft *F* is partly rotated to break the contact.

As the diameter at *B* is very small, it soon wears itself a seating into block *K* at *C*, which, when worn deep enough, allows contact point *M* to fall back on porcelain insulation tube *P* at *D* and also touch face of *K*, which causes friction, sticking and short circuiting.

The wear at *N N* is also a difficulty, as the holes wear larger, rust, dirt, etc., collect and prevent the smooth working of the shaft *F*. To get over these objections I added the following parts which have made an efficient mechanical apparatus of an indifferent one and saved us endless time and trouble with the 40-horsepower gas engine I adapted it to.

I counterbored the end of block *K* to the diameter of the large end of shaft *F* and inserted a high-carbon steel bush *A*, which projected out from block *K*, and so brought contact *M* well away from the porcelain tube. This gave plenty of metal for back pressure wear. At *G* is a wrought-iron forging which is attached to block *K* and engine by studs *J J*. In *G* a hole was drilled and reamed to take center *H*.

I is a nurled-head screw with lock nut and flange to fit in a cross slot of center *H*, to advance or return it. The center *H* serves a double purpose, as when regulated it prevents the severe pressure at *B*, the shaft can be an easy fit in bush *A* at bore *N* and still remain central while rotating. Also, owing to the free fit of shaft *F* in the bush *A* and at *N*, friction is reduced to face of *B* and point of center only. The center may be lubricated. As supplied by the makers, there is friction along the bore at *N N* and at *C*. These parts cannot be lubricated: at *C*, owing to the heat, and at *N N*, as they are not get-at-able.

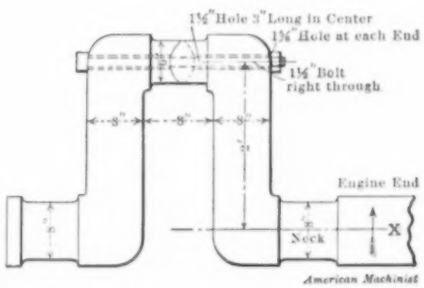
I might add that *M* is of nickel steel and the end of shaft *E* at *O* has a nickel-steel ring to withstand the high temperature of the combustion chamber and to prevent formation of rust, which is fatal to a good sparking result. All gas-engine operators know how difficult it is to get parts which are exposed to the high temperatures of the combustion chamber to work sweetly and I trust this kink will be of use to many of your readers.

Crank Shaft Repair

BY A. BROWNING

Particulars of a quick repair which I carried out at a timber yard in this district some time back may be of interest to your readers. A crank shaft operating the vertical saws of a tree cutter, having broken through in the neck, I was called up to examine it and report as to what could be done.

The fracture was at such an angle that the propelling end would still take the broken half around, providing the bearings would hold. On inquiry, I found the owners were placed in a very awkward position through this breakdown, so



REPAIR OF A BROKEN CRANK

I had to get it going again somehow.

First, I started four men to work, two at each side, with ratchets and drills, and on getting to within 1½ inches of the fracture from each side, the remaining 3 inches was finished from one side with a smaller drill. This enabled me to have the bolt a good fit at the point most needed. The bolt was placed in position, tightened, and hammered well over.

With this done they were able to complete work on hand in proper time. In fact, this repair carried them on for eleven weeks until, during the holidays, a new crank was connected at *x*, with couplings.

Letters *from* Practical Men
Concerning *the* Details *of* Making things *in* Machine shops, *from the* First Sketch *to the* Sale

Railroad Shop Handy Stands

I notice that the AMERICAN MACHINIST very seldom contains articles or descriptions of devices particularly adapted to railroad work. Would suppose that such items would be interesting, as you have a large circulation among railroad men.

Herewith am sending you two suggestion for useful articles on railroad work. The vise-stand is adapted for work between the pits in a roundhouse, or other places where there is not room enough for a bench, or where a bench is not required. The stand has proved satisfactory in actual service.

The adjustable stand for air-pump repairs has proved itself a great convenience and time saver in the air-pump repair rooms. As shown in the drawing, the air pump can be mounted on the stand and tipped to any angle from the horizontal to the perpendicular.

New York City. C. J. MORRISON.

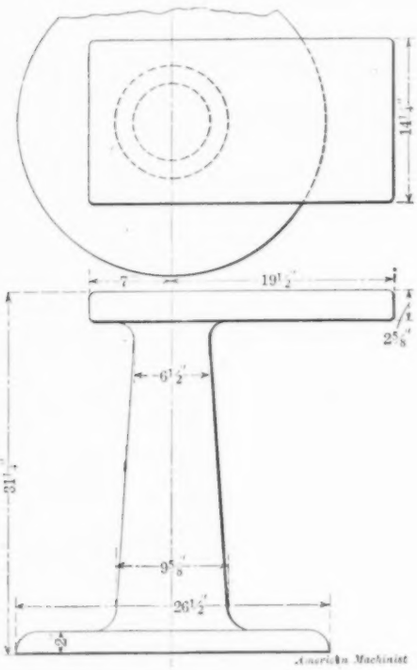


FIG. 1. VISE STAND

Re-forming a Hardened Milling Cutter

Having a large number of shafts as shown in Fig. 1, to mill, we had a cutter made by a leading cutter manufacturer which was found to be wrong when received; the radius *A*, Fig. 2, being too small. To anneal and re-work the cutter was not desirable for various reasons, but it was of no use in the condition in which it was received, as the work on the shafts must be accurate. The tool-room foreman finally came to the rescue and corrected the cutter on a small Cincinnati grinder. The rig used is shown in Fig. 2, which is self-explanatory. It will be noticed that there is no keyway in the arbor, so that the cutter may be secured at any point. The arbor is placed between centers on grinder at right angles to the emery-wheel spindle. An A1 job was obtained in this manner.

Pittsburg, Penn. W. H. MACK.

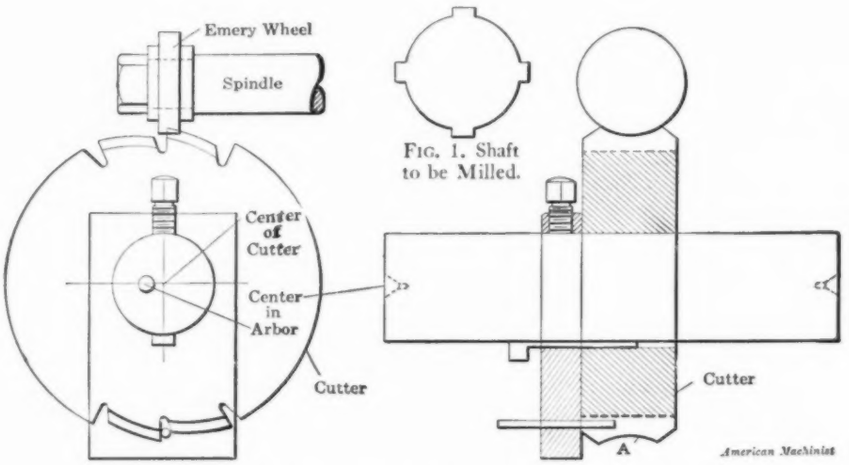


FIG. 2. ATTACHMENT USED TO BACK OFF HARDENED CUTTER

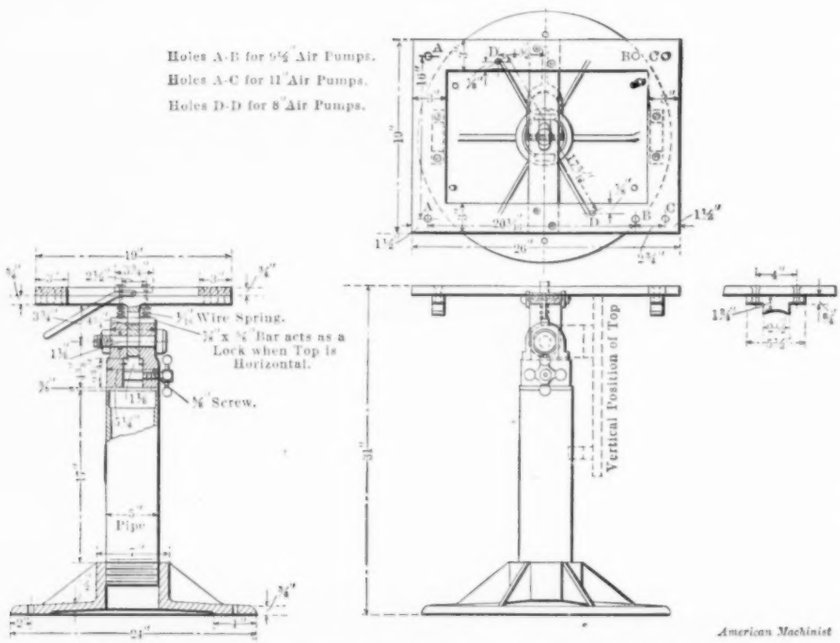

Holes A-B for 9½" Air Pumps.
Holes A-C for 11" Air Pumps.
Holes D-D for 8" Air Pumps.
Wire Spring.
Bar acts as a Lock when Top is Horizontal.
Screw.
Pipe
Vertical Position of Top
American Machinist

FIG. 2. ADJUSTABLE STAND FOR AIR BRAKE PUMP REPAIRS IN RAILROAD SHOP

It may be information to some to know exactly what "gold filled" means. In a booklet published by the famous dollar watch firm the process of "gold filling" is explained. It consists in taking two sheets of gold between which is placed a section of solder-coated base metal. To this "sandwich" heat and pressure are applied and the three sheets are welded together, the gold being on the outside.

Discussion *of the* Previous Question

Letters from Our Readers Showing how many Men of many Minds Look upon Various Subjects Opened up in previous Numbers

Calibration of Pyrometers and Lead Bath

I am always glad to have any of my articles criticized as they are my own productions; I have produced most of them from actual experience and appreciate the fact that my brother workmen may find some cause to differ with me; however, I do not like to be misquoted.

I note, on page 558, where W. H. D. states that he would call attention to a very serious error in my paper on the subject of "Why Are Pyrometers Discontinued," on page 1077, Part 2, Volume 32. He says: "In the first place, the freezing point of liquid sodium carbonate does not take place at 1497 degrees F.. The examination of a large number of samples bought in the ordinary way, shows that the freezing point falls between 1544 and 1557 degrees. There would probably be very little error, therefore, in presuming that pure sodium carbonate freezes at 1550 degrees Fahrenheit."

In my article I made no claim that sodium carbonate freezes at 1472 degrees. I state, however, that its melting point is 1472 degrees Fahrenheit, hence I would expect to find its freezing point a little below that. I have consulted several authorities on the melting point of sodium carbonate and find them to vary from 1472 to 1504 degrees. This, I presume to be due to the process of manufacturing. I am unable so far, to find any sodium carbonate with as high a melting point as 1550 degrees.

He then says: "Sodium carbonate very readily absorbs sulphur fumes from the furnace gases, and in this manner a portion of it becomes transformed into sodium sulphate, which has a very corrosive action on the iron casing of the thermo-couple. If the ash from the fuel or any sand or grit blowing about the shop happens to fall into the sodium carbonate, then it is at once fluxed with the formation of sodium silicate and the melting point is correspondingly lowered." If W. H. D. will again refer to my article he will note that we use considerable precaution in the preparation of the vessel for retaining the sodium carbonate and that the precautions stated were sufficient for anyone to understand that care must be used to prevent foreign matter from entering the liquid.

Some things I noticed in his former article but passed without comment, but now that he has called attention to them by the statement that "full instructions are given for accurate calibrating in his article on page 502, Part 2, Volume 32," I will make the corrections. He states that tin melts at 449 degrees, whereas tin (7.294 sp.gr.) melts at 455 degrees, and zinc (7.140 sp.gr.) melts at 842 degrees. He gives the freezing point of zinc as 787 degrees. Antimony (6.712 sp.gr.) melts at 1150 degrees; he gives the freezing point at 1159 degrees. Aluminum (2.560 sp.gr.) melts at 1157 degrees; he gives the freezing point of aluminum at 1214 degrees. Silver (10.553 sp.gr.) melts at 1749 degrees; he gives the freezing point of silver at 1763 degrees. The reader will readily see why I did not refer to his article from the above facts.

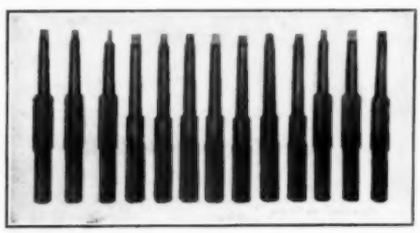


FIG. 1. REAMERS HARDENED IN LEAD BATHS

It also contains other statements which I cannot let pass without mentioning. He states that common table salt is an excellent metal for calibrating and that its freezing point is always between 1463 and 1472 degrees. In the first place,

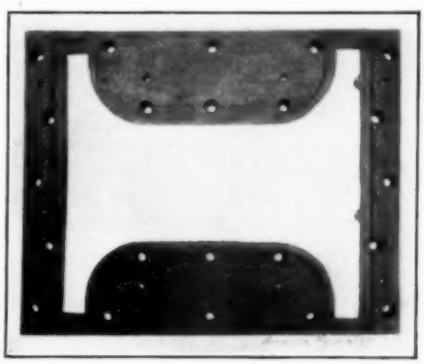


FIG. 2. DIE HARDENED IN LEAD BATH

I do not think that salt is a metal, and I have never known salt to melt at any such heats as he gives as the freezing points. Sodium chloride (common salt) sp.gr. 0.072, melts at 1421-6 degrees, therefore, there is nothing of interest in the information that he gives in this method. However, I use sodium chloride and find it superior to sodium carbonate.

The next method of calibrating that W. H. D. would have us use is surely interesting, especially to anyone who has ever observed the taking of the calesence and recalesence points. Let me say this to the readers. With the most delicate instrument in the line of pyrometers, we are advised to take from two to three heats in determining the calesence point and if any difference is recorded, we then take an average of the three heats in order that we may be correct. However, I do not find it necessary to take more than two heats in determining the calesence point providing the instrument, dial, etc., is working correctly. These instruments cannot be used for any other kind of work, neither can the calesence point be observed with the ordinary recording pyrometer; it must be an instrument especially designed for this purpose.

He says: "If the naked couple is available, a piece of, say, 0.90 per cent. carbon steel, whose critical temperatures on cooling have been carefully determined, can be used over and over again, as a hole is bored to receive the end of the couple. The piece of steel containing the couple should be placed in a small graphite crucible and may be heated either on the Smith fire or over the brazer's lamp. A piece of steel prepared in the manner indicated, has an advantage over most other substances which might be used for calibrating pyrometers and it is true that only a very limited range of temperatures can be checked in this manner, but the range for most purposes of heat treatment is the only one that is of any importance."

I use my calescent pyrometer and make comparisons with some of the best instruments in the country and do not find any variation worthy of consideration, yet I would not undertake to calibrate the common pyrometer by any such method, for I know it cannot be done. Then we would be obliged to say that we have not found any method, let alone a reliable method, in anything that he has proposed in his article on page 558. My idea in presenting this subject to the readers of the AMERICAN MACHINIST was, as has been previously stated, for the purpose of bringing out a standard method of calibrating and that the fullest details be given even to the amount of material to be used whether the reading should be made at the melting point or the freezing point.

In regard to the lead bath, he states that " the great disadvantages of the lead

bath are that the specific gravity of lead is greater than that of steel and that this is a very serious drawback when such things as springs are to be hardened and that the lead has a tendency to stick in the cavities and between the teeth, that it is easily oxidized and can dissolve its own oxide and sulphate and through the agencies of these substances, cause soft spots."

Let me say this: If lead does oxidize, it is up to the hardener to prevent it. If I were using coke for fuel, it would certainly be necessary for me to replenish my fire. If I were using gas, it would be necessary to regulate my fire. Any fire will need someone to care for it or it will be liable to act as though it were not being used for heating a valuable tool. Just so with the lead bath. It must be cleaned. Then lead must not be permitted to oxidize, it must not be permitted to reach a higher heat than is best for the steel to be hardened at. If a gas furnace is being used and sufficient gas turned on, it will smoke and the fumes are equal to that of crude oil. It is up to the hardener to prevent these things. If the temperature of a salt bath 12 inches deep is recorded at a distance of 2 inches apart, there will be found a variation of 14 or more degrees.

As to his objection that lead has a greater specific gravity than iron, will say that a tool weighing 2 pounds can be held in place in a lead bath with a pair of tongs weighing ½ pound. The reamers shown in Fig. 1 were heated in a lead bath requiring a pair of tongs weighing but ½ pound to hold them in place. There were 36 of these and 30 minutes was consumed in heating and hardening them in a lead bath, all being quenched at a heat of 1455 degrees. The die shown in Fig. 2 is 24x26 inches, and each piece of it was heated in a lead bath at a temperature of 1472 degrees. While there is considerable difference in the cooling surface on the two sides of this die, yet it warped only 0.003 of an inch.

The lead bath is not intended for springs such as I am inclined to think W. H. D. had in mind when he speaks of heating springs in lead. It is not intended for any tool that will not have sufficient strength within itself to stand the necessary pressure that may be required to force it through the lead bath. As for the lead causing soft spots, such as he speaks of, I must say that I do not understand how he can be so careless in the use of a lead bath as to allow it to get in a condition that will cause soft spots.

Lead is very easily cleaned by placing a block of wood on the end of a bar of iron, and as the lead melts, forcing the block to the bottom of the bath and allowing it to remain until the lead is boiled clean. I do not think that the lead bath is any better than the poorest fire on earth unless it has proper care; in fact, I do not think that any fire is of any value unless it is properly cared for.

I find it convenient to harden profile cutters, milling cutters, embossing dies, in fact, anything in the line of a tool that I can get in without cooling it too low. If we were to place a tool in the lead bath and allow it to remain the same length of time that it would require the tool to heat in a salt bath, we might then have some trouble with our lead even if it was cleaned. It is up to the hardener to use judgment and to know what to and what not to put into a lead bath.

The disadvantages that he speaks of are applicable to the cooling bath in the following manner. If a tool is cooled in a drastic bath, it is liable to break, but are we to keep tools from those baths in order to prevent them from breaking? Some baths, such as salt, will rust a tool. Are we to discard the salt bath in order to prevent rust? No, we must proceed with our work and overcome these difficulties and just so with the lead. If it is the one fire that positive heats can be taken in; if it is the one fire in which local heating can be done, with a preciseness that is impossible for anyone to equal with any furnace, including the salt bath, then why should we want to claim the salt bath to be superior to the lead bath, when it is possible for us to overcome all the objections that W. H. D. speaks of?

Lead can be kept clean by placing charcoal or anthracite coal over the top of the lead, thus preventing oxidization. If the lead sticks to the tools in the crevices, teeth, etc., then it is dirty. If we desire, we may take the tools from the lead bath and plunge them into a strong solution of sodium chloride, withdrawing with sufficient heat to permit the tool to be coated as if it were whitewashed and then return to the lead and heat. When the salt has melted on the tool, we may know that we have 1421-6 degrees, if the salt is 0.972 sp.gr. I have no hesitancy in recommending the lead bath for the most delicate tool, provided the lead bath is in proper condition and the work done in an intelligent manner.

Davenport, Iowa. C. U. SCOTT.

Concrete Floors

On page 513, M. H. P. A. complains of the vibration of reinforced concrete floors as compared with wooden floors.

Concrete is not so elastic as wood, and a properly designed reinforced concrete floor should exhibit no more vibration than a concrete floor placed directly on the ground surface. This I know as a designer and builder of reinforced concrete structures. If the facts are as stated, Mr. M. H. P. A. would better get a job in a safer building.

Chicago, Ill. MAC.

Tools for Forming Tubes

In answer to our friend H. D. Coventry who, on page 465, criticizes my letter published on page 1099, Volume 32, I wish to acknowledge my mistake in stating that a person could feed 10,000 gross of tubes per working day of ten hours through a drawing press. What I meant and should have said is, that a

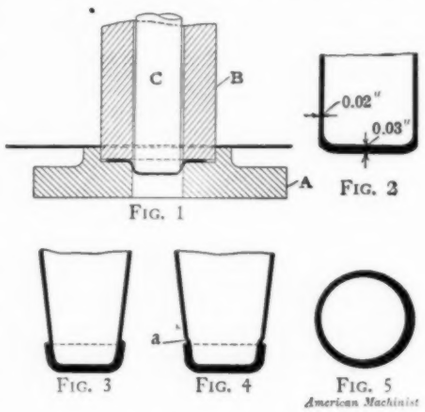


FIG. 1 FIG. 2 FIG. 3 FIG. 4 FIG. 5

American Machinist

TOOLS FOR FORMING TUBES

person can feed through 10,000 pieces in the time given. Now the mistake is so self-evident that I am sure Mr. Coventry did not set out to try it.

In regard to buckling of the metal which the same gentleman says is sure to take place if a 4-inch diameter blank is drawn down to a 2½-inch diameter cup in one operation, I would suggest that he look again at my letter and he will see that, referring to the first drawing, I have stated that the "diameter of the tools need not necessarily be of the dimensions given." I did not intend to give dimensions from which to make the tools. The kind of metal to be used and machine or press in which the work is to be done, must determine the size and form of the tools.

Very often, with new work, the only way to determine the above is by trial and, where it is necessary to experiment to determine the size of a set of tools, it is both wisdom and economy to start right; that is, to make the first drawing set so it will draw a cup as deep as possible. Then, if it is evident that it is too small in diameter all you have to do is to make another set of larger diameter and use the first set for the second drawing, instead of throwing it aside, as would probably be the case if it was made to draw an excessively shallow cup and it was found afterward that the cupping could be done with the next smaller set.

I agree with Mr. Coventry as to the form of his cup at the bottom corner for

cupping done in a single-action press; but, if the work is to be done in a double-action press, as I have been accustomed to do such work, then the corner must be as nearly square as the work will allow, without danger of the cup cracking at the corner.

The reason for this is that when using a double-action press for cupping, the blanking punch *B*, Fig. 1, holds the blank flat at the bottom of the blanking die *A* (which is also the top of the drawing die) to prevent crimping or buckling while the cupping punch *C* forces it through the die. This will result, if the punch *B* is not very accurately set or the stock is uneven in thickness, in the blank being held or pinched a little tighter on one side than on the other and, if the punch *C* is too rounded at the corner, it will slide a little on the blank toward the side of least resistance, resulting in a worthless cup or, in presshand parlance, a "monkey." On the other hand, if the punch *C* has a comparatively short radius at the corner it makes a "seat" for itself in the blank, almost as soon as the blank starts to enter the die; thus preventing sidewise slipping of punch. Mr. Coventry will readily see that with such tools it would not be impossible to draw a 4-inch blank down to a 2½-inch diameter cup.

Now as to thickness of tube: First let me call attention to A. B. Card's request on page 839. He says that he wishes to know how to make dies for forming tubes "about two hundredths of an inch thick" and not *twenty thousandths* of an inch, as seems to be Mr. Coventry's impression, and quoting further Mr. Card says that "It is not necessary that the tubes be of uniform thickness."

Considering the above, I do not see the need of worrying about fine limits and I must say further, that a person who might be afflicted with the quarter-thousandth variation limit bug, if he should try to apply it to common, ordinary press work, would certainly have a hard row to hoe; especially in drawing ferrules.

I will endeavor to show Mr. Coventry what would happen if a person should try to draw such tubes as Mr. Card has sketched out, from stock 0.010 thicker than finished tubes 0.020 inch thick.

First, we will assume that a tube has been drawn as far as it would be possible to go by following Mr. Coventry's suggestions; that is, until it is ready for the first tapering set. Then, to start the tapering we would have a tube which would look something like Fig. 2. This, by the way, I have doubts of being able to produce with a reasonable number of operations, without bursting at the bottom and requiring very frequent annealing. Now, if an attempt is made to taper such a tube, the further result would be something like Fig. 3 or, to be more exact, like Fig. 4; which, in either case would be no further use for tubes which are to be of comparatively uniform thickness all over.

The thought might suggest itself that the tube could be squeezed in the tapering dies, hard enough to reduce the tube to an even thickness, but I doubt if this could be done, even in a coin or embossing press, to say nothing of an ordinary drawing press. Even assuming that it could be pressed hard enough to reduce the part that is 0.03 inch thick, down to 0.02 inch, a depression or groove would still be left all round the tube, as shown at *a*, Fig. 4, which it would be impossible to get rid of.

Therefore, it would be seen that drawing a tube such as Mr. Card requests, by such a method, is entirely impractical; though it may be possible to make tubes of a uniform diameter throughout their whole length when finished, by this method. Still, it would require so many drawings and such frequent annealing, especially if the tube must be comparatively deep in relation to the diameter, that it would quite possibly render them more expensive than turning out of solid stock. Also you would not be sure of securing accuracy in thickness, for I have quite often seen tubes come out of the drawing press thicker on one side than on the other; as shown by Fig. 5.

In my opinion, a better way to do such work if it was important to have a straight tube of exact, uniform thickness and diameter throughout, would be to make them of stock that would give a drawn tube of enough extra thickness to allow it to be finished in a turning or grinding machine, both inside and out, to the required dimensions in thousandths of an inch, if necessary.

Now let me refer to Mr. Coventry's sketch on page 465, showing a stripper which I do not wish to criticize, as it has served its purpose well for many years back and is still doing so very satisfactorily today, where it is necessary to have it. You would certainly need one if you should attempt to draw tubes such as Fig. 2, for then the tube would be pressed so hard on and around the punch *C*, that it would be next to impossible to pull it off without such a device.

In ordinary practice, if a cup sticks so hard on a drawing punch as to pull up through the die, the punch and die are taken out of the press and to the tool room, where the die is lapped out by using the punch with cup thereon for a lapping tool. The operation is repeated with the next cup that pulls up through, until the evil is cured.

If the metal is not crowded too much between the drawing punch and die, the drawing die having a good sharp corner at the bottom and punch being as smooth as possible, stripping will take place without any trouble. The reason for this is that, the metal being worked, having a certain amount of elasticity, the tube or cup will immediately, upon having passed through the die, increase or swell a trifle, which (though little as it may be) is enough to prevent the cup from going up through, instead of stripping. It is all in making the tools right and using and keeping them in proper condition thereafter.

Worcester, Mass. P. P. MONFILS.

Making Square Holes and Keying Sliding Worms

At page 603 H. Terhune gives a description of what he calls a cheap method of making square holes in socket wrenches. We can bore them from solid bars and turn arbors for milling machines, etc., for press fits just as easily and cheaply as boring the hole round in the first place as described by Mr. Terhune. In reference to the methods described by R. Neilson at page 124 and S. O. Fowler at page 597 for keying sliding gears on shafts I wish to say that if we can turn arbors square, elliptical, or with three, five, six or more sides, and bore milling cutters, gears, worms and other articles to press onto them, we can also bore them to a running fit, dispensing with splines, keys and other holding devices and we thereby insure equable and positive drive for these parts.

Cleveland, Ohio. JOHN W. PAYLER.

A Reamer Grinding Kink

I notice at page 317 a reamer-grinding kink by Frank D. O'Brien, who states that he has had trouble in grinding some taper reamers as he could not get a wheel that would grind the eight teeth without glazing, thus making retruing of the wheel necessary. I had the same trouble myself some years ago when grinding reamers and cutters, but have no difficulty now. I use a Norton Alundum wheel 36 L, on small work, or on big work, a 36 J, with a good supply of soda water.

Birmingham, Eng. J. W. BISSELL.

To Make an Oilstone Work

To make the cheaper grades of oilstones or whetstones stick up to their work and do something, sprinkle a little flour emery upon them. You will be surprised how they will take hold and get down to business.

Chicago, Ill. M. JACKER.

Previous to electroplating, a benzine dip will be found advantageous and economical for removing grease and machine oil from finished castings. It will effect a noticeable saving of potash or lye.

Sizes of Motors to Drive Machine Tools*

By Charles Robbins

The accompanying tables, 1 to 10 inclusive, contain the sizes and speeds of motors usually employed, with the average duty indicated for machine tools. The constant-speed motors are selected with a view to utilizing speeds as near as possible to those obtainable with 60-cycle induction motors. By this means the same gear ratios can be employed with direct-current motors or 60-cycle induction motors.

The average load factor for motors driving lathes is from 10 to 25 per cent. On some special machines, as driving-wheel and car-wheel lathes, the cuts are all heavy, which increases the average load factor to from 30 to 40 per cent.

Size, Inches.	Horsepower.	Adjustable Speed.	Constant Speed.
24–30	5	Ratio 1:3	1200
36–42	7½		1200
60–90	10 5-rail		1200
100	15 5-rail		1200
10 feet	20 7½-rail		900
12 feet	20 7½-rail		900
14 feet	25 7½-rail		900
16 feet	30 10-rail		900

TABLE 1. SIZES AND SPEEDS OF MOTORS FOR VERTICAL BORING MILLS.

For extension boring mills, 5-horsepower motors are used to move the housings on from 10-foot to 16-foot mills, 7½ horsepower for from 14-foot to 20-foot mills and 10-horsepower for from 16-foot to 24-foot mills. The load factor of the driving motor on boring mills averages from 10 to 25 per cent.

The load factor of motor-driven drills is about 40 per cent., when the larger drills applicable thereto are used. If the smaller drills are used the load factor averages 25 per cent. and lower.

For the average milling operations the load factor averages from 10 to 25 per cent. On slab-milling machines, where large quantities of metal are removed, it will average from 30 to 40 per cent.

The work on this class of machinery is usually light and much time is required in making adjustments. Hence the load factor is rarely higher than 20 per cent.

On planers the load factor averages between 15 and 20 per cent. The motor must be large enough to reverse the bed quickly, yet this peak load occurs for such short intervals that it does not increase the average load per cycle very much.

The work done on shapers is of a vary-

*From *Journal*, American Society of Mechanical Engineers.

Engine Lathes. (Adjustable speed, Ratio 1:3.)

Swing, Inches.	Light Duty. Horsepower.	Light Duty. Adjustable Speed.	Light Duty. Const. Speed, R.p.m.	Medium Duty. Horsepower.	Medium Duty. Adjustable Speed.	Medium Duty. Const. Speed, R.p.m.	Heavy Duty. Horsepower.	Heavy Duty. Adjustable Speed.	Heavy Duty. Const. Speed, R.p.m.
14	2	Ratio 1:3	1800	3	Ratio 1:3	1800	5	Ratio 1:3	1200
16	3		1800	5		1200	5		1200
18–20	3		1800	5		1200	7½		1200
22–24	5		1200	7½		1200	10		1200
27–30	7½		1200	10		1200	15		1200
36–48	7½		1200	10		1200	20		900

Special Lathes.

Type.	Horsepower.	Adjustable Speed.
Car wheel, 48 inches	20	1:3
Double axle, moderate duty	15	1:3
Heavy duty	25	1:3

Driving Wheel Lathes.

Size, Inches.	Horsepower.	Adjustable Speed.
51	15	Ratio 1:3
60–69	20	
79	25	1200 R.p.m.
84	25	
90	30	
100	50 5 tail stock	

TABLE 2. SIZES AND SPEEDS OF MOTORS FOR LATHES.

Radial Drills.

Size, Feet.	Horsepower.	Adjustable Speed.	Constant Speed.
4	3	Ratio 1:3	1800
5	5		1200
6	5		1200
10	7½		1200

Upright Drills.

Size, Inches.	Horsepower.	Adjustable Speed.	Constant Speed, R.p.m.
Friction	¼	Ratio 1:3	1800
15	½		1800
20–26	1		1800 1200
28–34	2		1800 1200
42–50	3		1800 1200

Multiple-Spindle Drills.

Size, Inches.	Horsepower.	Adjustable Speed.	Constant Speed.
4–2	7½	Ratio 1:3	1200
6–2	10		1200
8–2	10		1200

TABLE 3. SIZES AND SPEEDS OF MOTORS FOR DRILLS.

Medium Duty. Size, Inches.	Medium Duty. Horsepower.	Medium Duty. Constant Speed, R.p.m.	Heavy Duty. Size, Inches.	Heavy Duty. Horsepower.	Heavy Duty. Constant Speed, R.p.m.
24x24	5	900	24x24	7½	900
30x30	7½	900	42x42	25	900
36x36	10	900	56x56	25	900
48x48	15	900	Frog and switch forge	30	900
56x56	15	900	12x10 feet	60	720
			14x12 feet	10 (rail) 75	...
				12 (rail)	720

TABLE 4. SIZES AND SPEEDS OF MOTORS FOR PLANERS.

Size, Inches.	Horsepower.	Adjustable Speed.	Constant Speed, R.p.m.
14–20	3	Ratio 1:3	1800
24	5		1200
36	7½		1200

TABLE 5. SIZES AND SPEEDS OF MOTORS FOR SHAPERS.

HORIZONTAL—PLAIN OR UNIVERSAL.

Table Feed, Inches.	Cross Feed, Inches.	Vertical Feed, Inches.	Horsepower, Mod. Heavy.	Adjustable Speed.	Constant Speed, R.p.m.
24	8	18	3	Ratio 1:3	1800
30	10	18	5 –7½		1200
36	12	20	7½–10		1200
50	12	20	10–15		....

VERTICAL MILLING MACHINES.

Table Diameter, Inches.	Spindle Diameter, Inches.	Horsepower.	Adjustable Speed.	Constant Speed, R.p.m.
28	4	5	Ratio 1:3	1200
32	4	7½		1200
40	4½	10		1200
54	5	15		1200
70	6	20		900

SLAB MILLING MACHINES.

Width of Table, Inches.	Horsepower.	Adjustable Speed.	Constant Speed, R.p.m.
24–30	10	Ratio 1:3	1200
36	15		1200
60	25		900
36 heavy	25		900
42 heavy	50		900

TABLE 6. SIZES AND SPEEDS OF MOTORS FOR MILLING MACHINES.

HORIZONTAL BORING, DRILLING AND MILLING MACHINES.

Spindle, Inches.	Horsepower.	Adjustable Speed.	Constant Speed, R.p.m.
3½	3	Ratio 1:3	1800
4	5		1200
5	7½		1200
6	10		1200
7	15		1200

TABLE 7. SIZES AND SPEEDS OF MOTORS FOR MILLING MACHINES.

LIGHT, MEDIUM AND HEAVY.

Size, Inches.	Horsepower.	Medium.	Adjustable Speed.	Constant Speed, R.p.m.
10	3	5	Ratio 1:3	1800
10–16	5	7½		1200
20	7½	10		1200
26–30	15	...		1200

GEARED SLOTTERS.

24–60	20	...	1:3	900

TABLE 8. SIZES AND SPEEDS OF MOTORS FOR CRANK SLOTTERS.

Diameter, Inches.	Thickness, Inches.	Horsepower.	Adjustable Speed.	Constant Speed, R.p.m.
12	⅝	2	Ratio 1:3	1800
15	⅝	2		1800
18	¾	3		1800
20	¾	3		1800
24	⅞	5		1200
32	1	7½		1200
36	1	10		1200

TABLE 9. SIZES AND SPEEDS OF MOTORS FOR COLD SAWS.

Size, Inches.	Horsepower.		Constant Speed, R.p.m.
	Medium.	Heavy.	
10x 50	5	7½	1200
10x 72	5	7½	1200
10x 96	5	7½	1200
10x120	5	7½	1200
14x 72	10	...	1200
18x120	10	15	1200
18x144	10	15	1200
18x168	10	15	1200
18x 96	10	15	1200
14-in. car-wheel grinder		30	900

TABLE 10. SIZES AND SPEEDS OF MOTORS FOR GRINDERS.

ing character. With light work the load factor will not exceed from 15 to 20 per cent.; with heavy work, the load factor will be as high as 40 per cent.

The conditions encountered on slotters are similar to those on shapers.

A Transverse Extension Head for the Heavy Slotter

BY J. T. TOWLSON

The provision of extension heads, generally, for heavy slotters enables the machine man to perform conveniently various operations on heavy machine details, which without such heads he would, undoubtedly, find most difficult, and in my opinion there are not many shops that can afford to get along without them.

On my heavy slotters, in addition to the extension heads referred to, I have provided what may be termed a "transverse extension head" and have found it a most desirable accessory in heavy slotting work.

In slotting the feet of heavy standards, which have considerable length and consequent proportionate overhang, it is generally necessary to provide an outboard support with an arrangement of rollers, to enable the work to be fed up to the cut. In place of this I have fitted our heavy slotters with an extension head of the transverse type. Fixed to the original tool face, is a heavy bolted flange, carrying a slide rest base 4 feet long. This is fitted with a traversing screw at both ends, each screw being for the purpose of giving feed motion to a separate tool box made to move along the slide base. Both boxes, which are of most substantial character, may be used at one time, or one may be laid off and the other put into use.

With the aid of this extension head I am able to slot a face 4 feet long, without shifting the job; dividing the time by two in consequence of having two tool boxes.

Even when not being used for large overhung jobs, the two tool boxes are factors of economy, as it is possible and convenient to slot two faces in the same line at one time, thus saving time and cost proportionately.

What appears to be a "safe and sane" method of boxing the compass has at last been seriously considered, with a probability of adoption for the United States Navy. By this method it is proposed to divide the compass circle into 360 degrees, beginning with north and proceeding to the right, or in clockwise direction. When this has been generally adopted, the different points will be located by their straight angular value in degrees, instead of being known as "southeast by east," and similar picturesque, but cumbersome expressions.

Suggestions for American Firms in Austria

By Frank C. Hudson

American manufacturers and exporters of machinery are, as a rule, treating Austria-Hungary and Germany as virtually identical countries. Looking through the list of the representatives for American firms, we find that in the majority of cases, the Austrian agency is placed together with the German agency. We read so often "Agency for Germany and Austria-Hungary" that this seems to be an established rule in America. We over here, can readily understand that it is convenient for American firms to have these countries (which do not seem, measured by the scale of your maps, much larger than two or three American States combined) united and represented by one firm.

I must advise Americans of establishing separate agencies for Austria-Hungary, which also can cover the trade to the Balkan states, as much as there is. Austria-Hungary is too large an appendix to Germany, and the territory of this country is, indeed, larger in size than Germany itself. Moreover, there are a great many languages spoken in the former country. You will find that a German firm trades in German exclusively and if there is anyone in the firm that speaks another language, it is French or English.

In Austria, however, a firm whose staff is not able to cope with three or four of the main idioms spoken in the country —for instance, Bohemian, Polish, Hungarian, etc.—cannot live. You will see by this that the German firms are greatly handicapped in Austria, and that all they can do is to work the country from outside, and only the German part of this country, which is a smaller fraction of the Austrian empire than is believed by you. Even in the German parts of Austria, not to speak of other parts of this very polyglot state, there is a rather antagonistic feeling against the Germans and especially against their business methods.

The Austrians are more conservative, slower than the Germans, and will not be hustled. They like to be served by people who thoroughly understand their own ways. Business there is transacted on a basis of friendly intercourse, and the matter-of-fact practice of Germany is thoroughly disliked there. With the exception of two or three well known and large German houses of American machinery importers, there is not one firm of agents who have their own branch office in Austria and an Austrian staff. Such firms of agents, as a rule, accept the Austrian agency from American firms, together with the German one, because they do not want to create trouble with the American houses, who generally insist on throwing the Austrian agency on them. To work Austria from their business residence in Germany, which is very often far distant, is a very unprofitable business, and is, as a rule, treated as a negligible quantity by such representatives. It often happens that these representatives, in order to do something for their principals, place the Austrian business in the hands of Austrian firms and split the commission. It should, therefore, not be wondered at if the different people who handle this business are not too eager to use vigorous methods, and it seems quite clear that the results are accordingly not large. It might well be presumed that such discouraging results lead American firms to the belief that Austria is not a good business ground for their products. Such, however, is not the case. As said before, Austria is a very conservative country and all the German firms combined have hitherto not been able to shake the stern belief in the American machines, as has been done in Germany.

The import duty for German machines in Austria is quite the same as the import duties for American machines, and consequently, American machines are, as regards prices, in a more favorable position than in Germany. Austria is just now waking up to the exigencies of the time as regards the necessity of labor-saving machines. Labor has become dearer and dearer, and the large number of people who, in the last century, did not know what a labor-saving machine meant, because of the ridiculously small wages, are fast disappearing. The factories have to modernize their shops, if they want to exist.

Generally speaking, Austria is at present in a condition similar to that which existed in Germany about 15 years ago. The demand for machine tools is increasing and the reputation of the American machine tools stands uppermost in the opinion of the consumers. It seems, therefore, advisable for the American firms not to neglect this country, as has been done up to now. They should treat it as an individual country with an increasing demand for modern machinery which will in the future have to be met by someone. It is quite probable that if the Americans do not hasten to get their share of the business, it will go to someone in Germany.

Extracting Small Slivers

James F. Hobart

Frequently a workman is unfortunate enough to get small slivers of wood or of steel or iron into the flesh and have them break off level with the surface of the skin. These little slivers may be only 1/16 to ⅛ inch long and not more than 1/64 inch in diameter at the largest part, but they prove most aggravating pests and render a man thoroughly uncomfortable for hours. Often such slivers are invisible to the naked eye, being about the color of the skin, and to detect them is impossible by ordinary means.

Scraping the part with a sharp knife will sometimes remove such slivers, but that method cannot be depended upon. A man will scrape and scrape until he thinks the offender must have been pulled out, but in a few minutes, something touches the part and there is not the least doubt as to its presence. To leave such slivers in the flesh until a fester forms and the foreign matter is ejected, is a dangerous proceeding. Germs were undoubtedly forced into the flesh with the sliver, and the sooner it is removed, the better, although no harm results in the large majority of cases, from such slivers remaining in the flesh for 24 hours or more. Still, this should not be permitted. It is dangerous.

With the aid of a small pocket magnifying glass, the sliver may readily be found and removed. I always carry a little glass about 1 inch in diameter, double, one or both lenses being used as found necessary. When a "blind sliver" has been picked up, the little glass is swung out of its hard rubber case upon which a small weight is placed to keep the glass on the corner of a bench where the light is good. In the sunshine is best if possible. Then bring the eye down toward the glass and juggle the sliver location under the glass, when the eye will quickly locate the offender. Have a knife with a very sharp, pointed blade ready in the other hand; bring the blade to the sliver and you can pry out the spike (it looks like one through the glass) without further trouble.

A small percentage of ground asbestos added to paint, is said to impart a number of desirable qualities. Besides giving what painters call "tooth," or "feel," under the brush, it gives a much stronger surface to the coating and greater resistance to cracking.

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Contents

	PAGE
A Systematic Solution of the Belting Problem	763
The Newall Standard Metric Allowances for Various Fits	768
Machining a Clutch Gear	769
Reboring Valve Seats, Machining Engine Ports	770
Some of the Methods Used in Building the Locomobile	771
Heat Transmitting Properties of Copper Sheets	775
English Workman's Labor Exchanges	776
A Combination Boring Machine	777
Three Cam Cutting Machines	778
Recentering Hollow Square Automobile Transmission Shafts	779
Apprenticeship System of the Fore River Shipbuilding Company	780
Employers' Liability Insurance	782
The Machine Rate Plan of Cost Keeping	783
Interesting Fixtures Used in a Machine Tool Shop	784
Buying Some Machine Tools	785
Machine Tool Calculation for Drills	786
Economy of Removable Driving Box Brasses	787
Improving Gas Engine Igniter	789
Letters from Practical Men: Railroad Shop Handy Stands....Reforming a Hardened Milling Cutter	790
Discussion of the Previous Question: Calibration of Pyrometers and Lead Bath	791-793
Sizes of Motors to Drive Machine Tools	794
Suggestions for American Firms in Austria	796
Fallacy of the Large Shop Orders	797
Intensive Production	798
New Tools and Machine Shop Appliances	799

American Machinist

Editorial

Fallacy of the Large Shop Order

Americans are said to like big things. This liking extends even to shop orders and we frequently hear statements like this, "we make those gears a thousand at a time," "we order those screws in 10,000 lots," "we are just getting in shape to put through big manufacturing orders." The presumption is that large manufacturing orders are desirable—the bigger the better. While this conclusion is generally accepted, it is by no means generally true as a little consideration will show.

As ideal propositions, no parts of machines should be finished until they are wanted to use or to ship; the time consumed by parts and machines in process should be as short as possible; raw material should not be delivered until it is ready to be worked upon. Or broadly, the time from the receipt of raw material to shipment of product should be reduced to a minimum.

Practical manufacturing conditions modify these propositions to a great extent and to varying degrees in different factories. Yet the large stock of raw material, the large order in process and the large store of finished product are but thinly veiled disadvantages and may indicate the laxity or insufficiency of a shop management.

Stores of raw material and finished product are like overfilled reservoirs connected by a stream subject to the floods and tidal waves of huge manufacturing orders; a situation that pictures danger, if not disaster. How different from a continuous, rapid-flowing manufacturing stream from the seller of raw materials at one end to the purchaser of finished products at the other!

The advantages of the large order are said to be a shorter time per piece because the setting-up time is distributed over a larger number of pieces; a larger supply of stock on hand when the order is finished, and greater accuracy of production.

To look at the other side, it is by no means axiomatic that the large order gets through the shop in a shorter time per piece than the small order. In fact, the reverse is usually true. We recently saw some interesting figures on this point. Investigation had been made in a certain shop to determine the best size for manufacturing orders. The idea for certain work had been that 500 pieces were about right; investigation showed that 50 was a better number. A summing up of the actual cutting time on the series of operations on this piece gave a minimum time factor. For the 500-piece lot this time factor per piece was just about doubled. For the 50-piece lot the factor was about 1.5 times the minimum, with every expectation of lowering this to about 1.3 times the minimum. It is not difficult to discover the reason for this longer average time consumed in getting through the large orders. The natural inertia of size must have a considerable effect. The probabilities of waits for machines are increased provided large orders are going through the plant. And there is a tendency to increase all of the waits beyond proportion because of the very size of the order.

From the fact that it takes longer for a piece to get through in the large order than in the small order, the expense that should be charged against that piece is greater because of the longer occupancy of floor space, greater amount of care while in process, and interest on the money tied up in material and labor put into the parts as they progress. Again, the longer time consumed in getting the parts through the factory, the greater the possibilities of the parts becoming superseded or requiring change before they can be shipped.

To illustrate, let us assume that a piece has a series of operations that total one hour, and that the factors noted above hold; that is, 1.5 times the minimum for lots of 50, and two times the minimum for lots of 500. Applying these factors, the time to get a lot of 50 through the factory is 75 hours, and for a lot of 500, 1000 hours, or roughly, 1½ weeks and 18 weeks respectively. In the first case, use of floor space, attendance, interest on the money invested and the tying up of capital extends over a period of 1½ weeks, in the second case these factors are spread over a period of 18 weeks. This shows the fallacy of large manufacturing orders.

The same principle applies, as we have stated above, to large stocks of raw material and large stores of finished product. The longer they are kept the greater is

their real cost, and as the inventory prices and selling prices are never advanced just because the material has been in storage for a long time, the longer the period of storage the less the final profit.

An influential stockholder in a machine shop was asked recently to give his views in regard to enlarging the capital stock of the company. He replied, in substance: "I shall be very glad to take my quota of the increase of stock provided the money thus raised is to be used to build new buildings or to buy new equipment, but I will not contribute one dollar to increase the working capital of the company." The working capital of a company must be turned over as often as possible in order to realize the possibilities of profit. Unnecessarily large manufacturing orders tend to reduce the number of times the capital can be turned over in a year and thereby tend to reduce the possible profits.

Intensive Production

There seems to be no doubt that consumption of food stuffs is increasing faster than the production. And the logical answer seems to be to speed up the production. Not by buying more land but by using what we have to better advantage. This is what we call intensive farming and we all realize that it is the right thing—for the farmer.

But do we always try to apply the intensive idea in the machine shop?

When business begins to pile up and deliveries must be put off or orders refused, we are very apt to build an addition to the shop and secure all our increase of capacity by putting in more machines of the kind already in use. This is equivalent to the farmer who buys more land instead of increasing the productivity of that already under cultivation.

But this increasing of shop capacity by adding more floor space has a serious side when orders get down to normal or even below. The increased investment in buildings, lands, insurance, taxes, etc., are all added to the fixed or overhead charges and are always with us.

Of course, shops must increase from time to time, but before enlarging acreage it is a wise move to look the shop over very carefully to see how much its capacity can be increased in the same floor space.

This can sometimes be done by rearranging tools; grouping them to handle work with less delay; increasing speeds or feeds, or both; making new tools and fixtures, guaranteeing piece rates against cuts or putting in new machines that will greatly increase the output per square foot of floor space and per man.

If a special lathe will turn out double the work of the old one, sell the other and put in the intensive producer. It can hardly cost as much as another lathe and the new shop to put it in, but even if it does, it is cheaper to do it. It keeps your plant more compact, requires less superintendence and is better in every way.

Generally speaking, a shop should not be enlarged as long as its capacity can be increased in any other way. A new shop makes a gratifying item in the newspapers, but many a gray head can be traced to a shop that was a burden when the boom had become a memory.

NEW PUBLICATIONS

ENGINEERING BOOK NOTES. Published by the McGraw-Hill Book Company, 239 West Thirty-ninth street, New York City.

This is the first issue of a publication intended to supply book buyers with the latest information concerning technical books of all kinds. In addition to the regular book list it contains some interesting notes and comments on books and authors, written in an interesting manner which is far different from the usual publication of this kind. Copies will be sent on request to any address.

THE MODERN GAS ENGINE AND GAS PRODUCER. By A. M. Levin. Cloth 500 6x9-inch pages; 181 illustrations; 36 tables; indexed. John Wiley & Sons, New York. Price $4.

The author evidently knows his subject unusually well, but some of the methods of expression are unfortunate, especially as the work has great intrinsic merit. Yet these do not detract from the real value of the work, but are more in the nature of easily corrected blemishes that will undoubtedly disappear in future editions.

Technically, the book is remarkably free from errors and prolixity; Mr. Levin's principles, so far as the reviewer has had time to analyze them, are quite beyond cavil and his explanations are well condensed and direct. Chapter VIII, dealing with the practical gas-engine cycle, is particularly good, technically, although the use of the coefficient y to cover the discrepancy between theoretical and actual values of mean effective pressure seems an unnecessary refinement in view of the fact that no rational estimate can be made of its value, which ranges from about 0.5 to something like 1.5, according to a number of erratic and independent variables in operating conditions.

Chapters IX, X and XI, devoted to mechanical details, are especially praiseworthy; it is regrettable, however, that the author gave such scanty attention to piston-rod packing, which is a serious problem in large engines; his effort in this direction is restricted to a rather perfunctory description of the Schwabe packing. The chapter on methods of governing needs to be brought up to date, and the explanation of the methods used by the Allis, Snow and Westinghouse companies should be included in this chapter instead of being buried in a mass of engine descriptions in Chapter XIV. The chapter on producers is excellent as far as it goes, but its scope should be increased to cover all of the representative types of producer plant. The test data in the appendix are inadequate; an instructive analysis of the performances is impossible from the data given. The chapter headings are: Introduction to Thermodynamics; Design Constants and Formulas; Theoretical Analyses of the Gas-Engine Cycles; Power, Size and Speed of Gas Engines; Fuels, Combustion; Gas-Engine Fuels; Alcohol Fuels; Features of the Practical Gas-Engine Cycle; The Flywheel; The Crank Shaft, Engine Details; Governing; Engine Auxiliaries; Various Engine Types; Producer Gas and Gas Producers.

OBITUARY

Henry Reynolds, president of the Reynolds Company, screw manufacturers, died April 16, at his home in New Haven, Conn. He was 86 years old and born in Southbridge, Mass. He entered business with Ottie Tufts, of Boston, and was for a time part owner of the American Machine Works, of Springfield.

PERSONALS

Items For This Column Are Solicited

Edward W. Burgess has resigned his position in the engineering department of the Metzger Motor Car Company, of Detroit, Mich., to accept a position in the experimental department of the J. I. Case Threshing Machine Company, Racine, Wis.

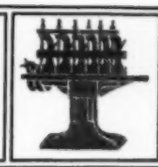
Duncan H. Macdonald, formerly mechanical superintendent of the Minneapolis Steel and Machinery Company, Minneapolis, Minn., has accepted the position of superintendent and mechanical engineer of the Southern Engine and Boiler Works, of Jackson, Tenn.

L. R. Meisenhelter, formerly connected with the Vandyck Churchill Company, at Philadelphia, has recently accepted a position as manager of the National Hartel Light Company, of Philadelphia. Mr. Meisenhelter is well known among the machine-tool manufacturers of the Middle West.

It is interesting to note that if a piece of lace is placed on an iron plate and a dish of gunpowder, and the latter detonated, the lace will be destroyed, but its impression will be clearly stamped on the iron.

New Tools *and* Machine Shop Appliances

Showing New Ideas *in* Machine Shop Equipment *that* make *it* possible *to* do better work at a reduced cost



New Landis Grinder

The illustration shows another new grinding machine built by the Landis Tool Company, Waynesboro, Penn., and which is known as their 16x72-inch heavy duty machine. The illustration shows the machine fitted with a gap in the bed for grinding locomotive piston rods after the piston head is in place. This gap can be located at any desired position on the bed, and the machine is also furnished plain, built without the gap for plain work, being especially designed for grinding chilled rolls.

The grinding wheel is 24 inches in diameter and the guard is made to accommodate wheels having a 4-inch face, and a full sized wheel can be used in grinding a 16-inch roll. An equalizing fixture is attached to the face of the headstock which drives the roll with equal force from opposite points across the center so as to compensate for any slight error in the alinement of the headstock and roll axes. These are not shown in the illustration, but are supplied regularly for roll work.

ANY new or improved machine or shop appliance of interest to our readers will be illustrated and described in this department.

A full and more detailed description will be given—when of special interest and it appears here before being sent elsewhere.

ALL descriptions appear in all four editions of the paper—Weekly, Monthly, Weekly English and Weekly German.

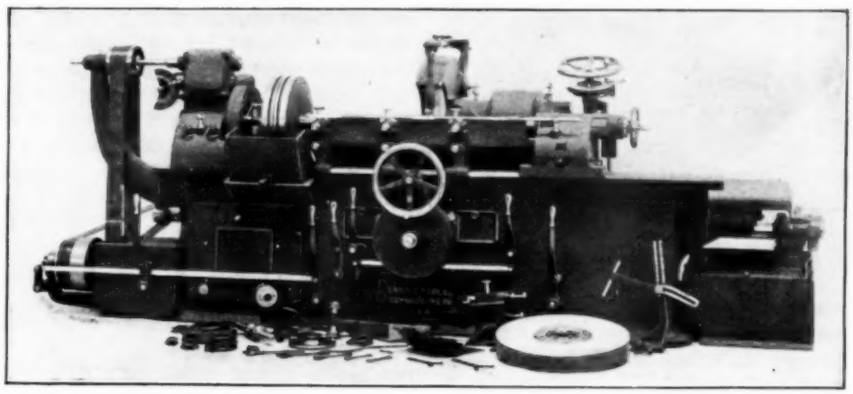


FIG. 1. MACHINE WITH GAP. FRONT VIEW

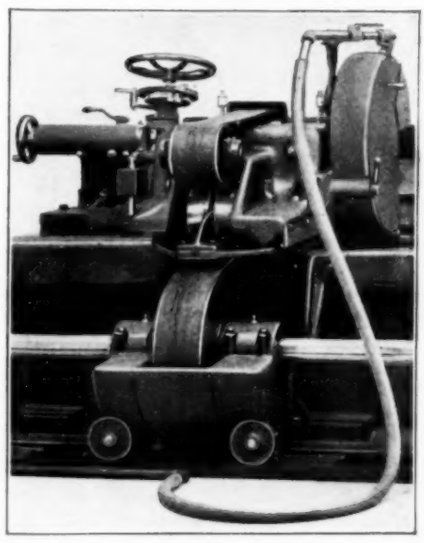


FIG. 2. REAR VIEW

The wheel is driven from the rear as shown in Fig. 2, the driving pulley being splined to the long shaft, which is supported by the carriage shown. The belt is six inches wide, and the intermediate pulleys automatically preserve the desired tension. This belt has almost 200 degrees of contact on both driving and driven pulleys, and the length can vary eight inches before taking up. The headstock is powerfully geared; has ten changes of speed for the work. These speeds are indicated on the dial shown at the left of the machine.

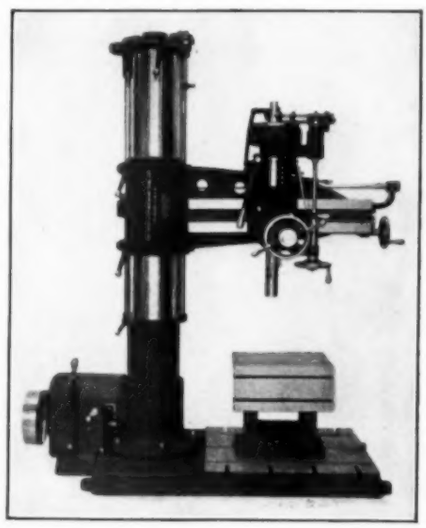
The work and traverse drives for the wheel are started and stopped together by a clutch or can be operated separately if desired, and their speeds vary independently of each other. These machines are equipped with electric motor drives when desired, but the rear shaft shown in Fig. 2 is retained in every case and transmits power to all the various parts of the machine, including the pump. The grinding wheel has a special provision for balancing, and the wheel head has specially protected bearings to keep out all dust and dirt.

Mueller Radial Drill Press

In the new radial drill press illustrated herewith, manufactured by the Mueller Machine Tool Company, Cincinnati, Ohio, special efforts are made to give stiffness and eliminate vibration. The column is cast in one piece, heavily webbed inside, and ground to size. The arm may be swung completely around the column and may be lowered at twice the speed of raising. A graduated ring is provided on the column for easily and exactly relocating the position of the arm. The drilling head may be located on the arm to 0.001 inch by graduated dial on end of arm.

The back gears are located in the head, as is also the tapping mechanism, which is designed for heavy work. Backing out may be done at considerably increased speed. An adjustable gage nut allows the spindle to slip when tap reaches bottom of hole, thereby preventing breakage.

In the feed, which provides both positive and friction drive, there are eight changes, in geometrical progression to each spindle speed. The spindle is of high-carbon crucible steel and has twelve speed changes, all available, without stopping. Spindle has quick advance and



NEW MUELLER RADIAL DRILL PRESS

return. The automatic trip has a safety stop and a graduated bar on spindle counterbalance weight is set to zero when drill enters. There are several adjustable dogs to trip the feed as often as desired. Speed box is of the geared-friction type and provides six changes of speed.

Plain box table, illustrated, is furnished, but universal box table, plain swinging table, worm swiveling table, and round table can be furnished at extra cost. Machines may also be furnished for any type of motor drive. Special attention is given to having all control and speed-changing levers in convenient positions in front, and to eliminate shocks in all speed changes.

All Geared Drive Shaper

This shaper, as illustrated in Fig. 1, has an all-geared drive operated from the plain, tight and loose pulleys on the further end of the driving shaft. The changes in the cutting strokes are obtained by four sets or pairs of gears thrown into mesh by the aid of a pinion shifting device illustrated in Fig. 2. The four changes obtained by this mechanism are increased to eight by means of back gears inside the column. These back gears are engaged or disengaged by means of lever No. 1, Fig. 2. As illustrated, the main shaft runs through bearings in the column and the two sets of gears are shown at either side. Lever 2 in front is used to engage the different pairs of gears by sliding them into position, after which it locks them firmly against lateral movement. By shifting this lever while handle No. 3 is in position *A*, the first two changes are made; upon moving handle No. 3 to position *B*, two more changes are obtained with lever No. 2. This construction, of course, does away with the necessity for a countershaft, eliminates the shifting of belts and allows the belt to operate under uniform pull with the different speed changes and without slipping. Where required a motor drive is furnished, direct connection being made between machine and motor by suitable gearing. This shaper is built in several sizes by the Smith & Mills Company, Cincinnati, Ohio, and aside from the features mentioned is of the same general pattern as their regular back-geared crank shapers.

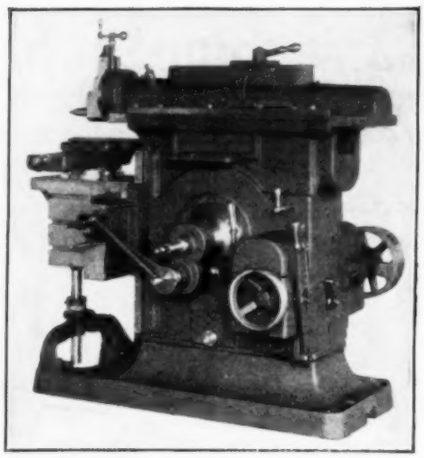


FIG. 1. ALL-GEAR DRIVEN SHAPER

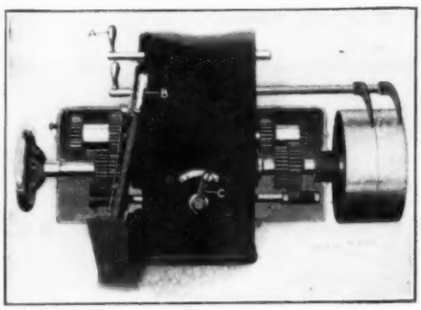


FIG. 2. SHAPER DRIVING GEAR

Universal Automatic Staff Lathe

The machine illustrated by the accompanying halftones is one of the line of automatics built by the Davenport Machine Tool Company, New Bedford, Mass. This machine is constructed for automatically turning staffs for clocks, also steel pinion blanks for cheap watches and for small clocks, speedometers, pressure gages, electric recording watt meters and a wide variety of work which is very small and delicate as the double-spindle feature provides the necessary support for such light work. It consists essentially of a pair of spindles mounted in line with each other and adapted to receive the work to be operated upon, while at the front is carried a rotating cutter head, which is so mounted as to permit of its being fed longitudinally and also swung backward toward the spindle as required in taking the different cuts on the work. The cam shaft extending the length of the machine is fitted with various disks and cams for operating different parts of the mechanism.

The turret at the front carries seven cutting tools and as it can be traversed sideways and also swung toward or away from the work, it permits the staffs to

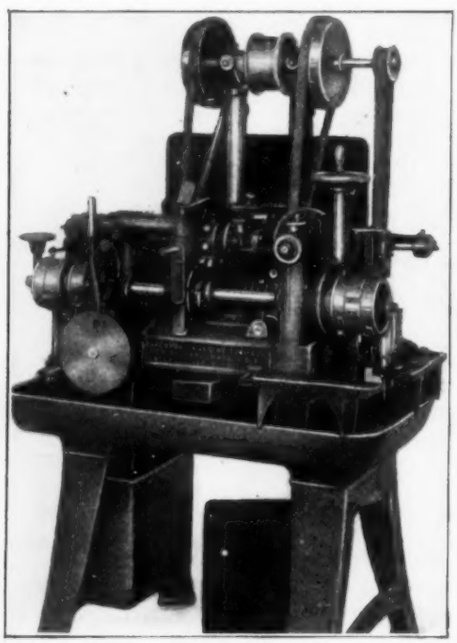


FIG. 1.

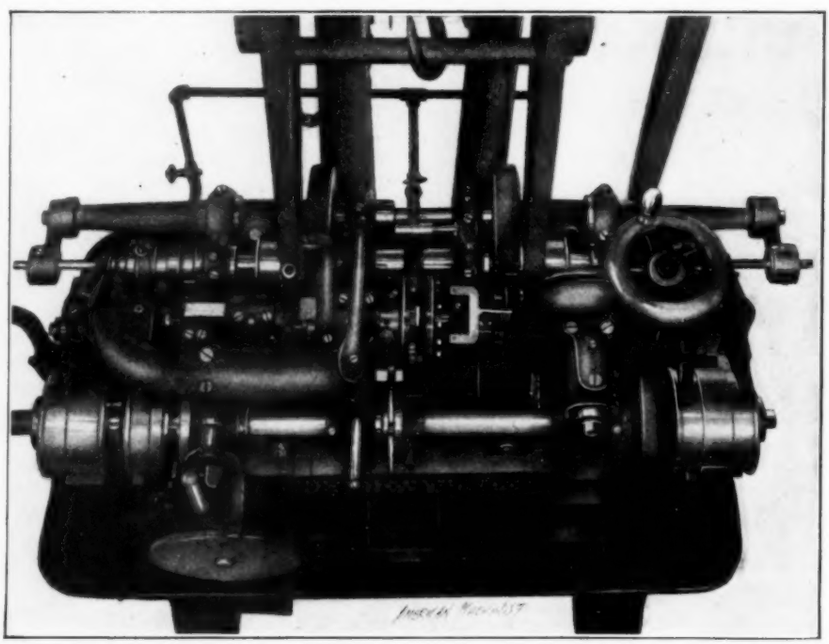


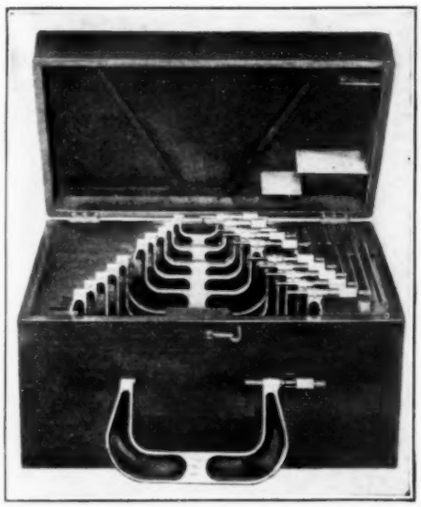
FIG. 2.

UNIVERSAL AUTOMATIC STAFF LATHE

be either turned, formed or completed by a combination of both operations. In operation, the stock is led forward through the left-hand spindle and is grasped at the end by the chuck in the right-hand spindle. It is then rotated by the two spindles while the pivot-turning and other operations are being performed. After the different cuts are taken on the body and pivots, a pair of cut-off tools in the turret, which are spaced the right distance apart, cut the work off to length, after which the chucks open, the stock is advanced again and the operations repeated on the next staff. The notched disk shown at the front of the machine is an indicating device which may be set to stop the machine when the length of wire has been worked up.

A Set of Micrometers

The halftone shows a set of micrometers packed in a box which has recently been added to the line of precision measuring tools made by the Brown & Sharpe Manufacturing Company, Providence, R. I. The set covers the complete range



A Set of Micrometers

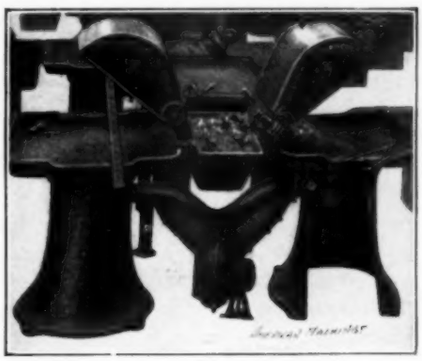
of measurements from 1 to 12 inches, or from 25 to 300 mm.

The frames are of I-section, making them light, rigid and strong. It is strengthened wherever there is danger of strain, while in other places it is lightened.

All parts subject to wear are hardened and adjustment is provided against wear. A complete set of solid test bars is included with the set for calibrating from time to time. The measuring surfaces are left square so that it is easy to measure small projections on plane surfaces. The micrometers can be furnished either singly or in sets, one set comprising 11, while another has 6 sizes of micrometers.

Independent Forge Blower

The illustration shows the new multivane forge blower made by the B. F. Sturtevant Company, Hyde Park, Mass., in place between two forges. This is electrically driven so that the forge can be placed in any desired position. The



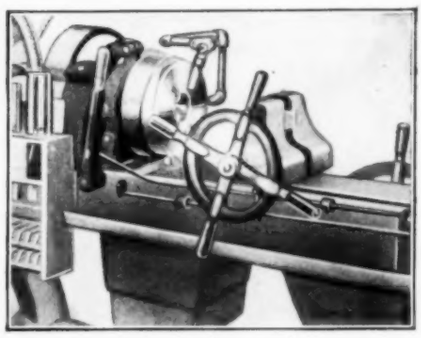
Independent Forge Blower

independent blower is considered preferable in many ways to having one large blower take care of several forges.

Automatic Opening Die Head

A product of Wells Brothers Company, Greenfield, Mass., in the form of an automatic opening and closing die head for their "Little Giant" bolt-cutting, nut-tapping and pipe threading machine, is illustrated in the accompanying halftone. The makers are now furnishing this automatic device on all of their 1-, 1½- and 2-inch opening die head mahines. Provision is also made, however, for opening and closing by hand, as before, when desired.

By means of this automatic device the



Automatic Opening Die Head for Threading and Tapping Machine

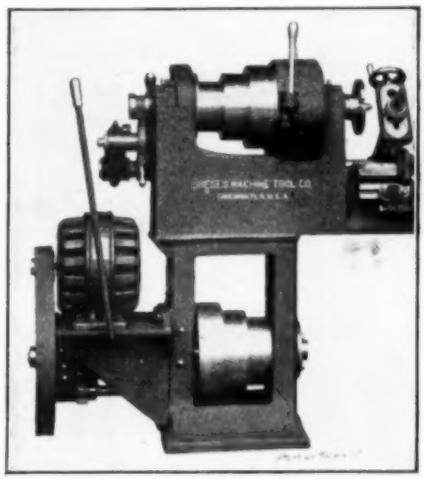
dies are opened and closed by the movement of the vise carriage with the intention of not only making the machine easier to handle but to give more uniformity of length to the product. The operation is secured by a cam ring having knock-out projections on the outside, together with an upright spring stud in the bed of the machine, and side rods carrying adjustable stops.

It is also claimed that by this arrangement blind holes can be tapped in work held in the vise, to good advantage.

Universal Monitor Lathe with Motor Drive

The halftone illustrates a motor drive as applied to a 16-inch universal monitor lathe built by the Dreses Machine Tool Company, Cincinnati, Ohio, the same driving arrangement being used on all of this company's screw machines, turret and brass lathes.

As will be noticed a countershaft cone is placed in the cabinet under the head, the motor is mounted on a substantial bracket and the rawhide pinion on the armature shaft is connected with a large gear on the lower cone shaft. This enables the machine to be operated satisfactorily at the high speed at which a brass lathe must be run. There is a friction connection between the motor and the cone-pulley shaft, and by means of the long vertical lever in front of the motor, the friction device is operated to start, stop, or reverse the lower cone-pulley shaft instantly without stopping



Universal Monitor Lathe with Motor Drive

the motor. The arrangement is placed close to the floor so as to give as long a belt as possible and prevent vibration. The motor is of the constant speed type, of 2½ horsepower. Where a variable-speed motor is used, the cone pulleys are replaced by plain pulleys.

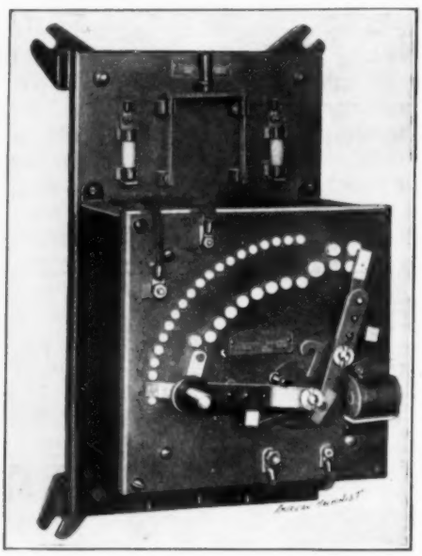
Hand Utility File

The Carver File Works, Philadelphia, Penn., are making what is known as the Delta Hand Utility file for general use among mechanics. It is a single-cut file, having large teeth with a coarse pitch and is particularly recommended for use on soft metal, wood, marble and similar substances.

Speed Controller for Machine Motors

This new controller developed by the General Electric Company, Schenectady, New York, consists of a starting rheostat, the arm of which is provided with a projection carrying a sliding contact which moves over the contact buttons connected to the field resistance. An auxiliary arm on the right-hand side of the rheostat front serves to maintain a short circuit on the field resistance during the period of starting the motor, and on the starting resistance, when the arm is turned back to vary the running speed of the motor by regulating the field current.

When starting the motor, the starting arm cannot be left in any position on the

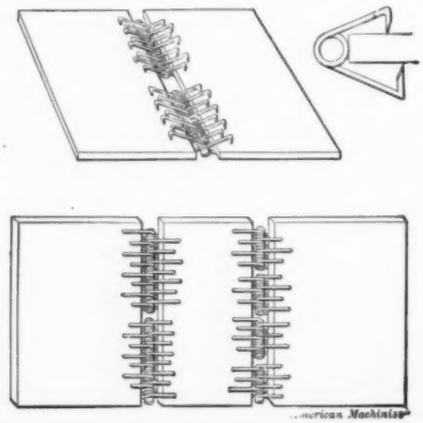


MACHINE-CONTROLLING RHEOSTAT

contact button, due to the action of a spring, but must be turned to the right until it engages the auxiliary arm, forcing the latter to be retained by the no-voltage release coil. The auxiliary arm then withholds the spring actuating the starting arm and thereby makes it possible to leave the arm in any position on the field contacts which will give the desired speed control of the motor. If the operator released the rheostat arm at any position while it is being moved to the right during the starting period, it will immediately return to the off position. Upon failure of voltage the retaining coil is demagnetized, releasing the auxiliary arm, which in turn releases the spring which carries the starting arm to the off position, thus opening the motor circuit. The rheostat is so designed that it requires a little extra pressure to move the arm beyond the maximum-speed point, the object being to call the operator's attention to maximum-speed position so that he will not unintentionally shut down the motor. When it is desired to stop the motor the switch arm is thrown to the off position, deënergizing the retaining magnet and releasing the auxiliary arm, which then opens the motor circuit. The maximum attainable speed variation is 3:1.

A Hinge Joint Belt Hook

The line-cut shows a hinge joint belt hook which has been put on the market by the Webb Hinge Belt Hook Company, Boonton, New Jersey. It consists

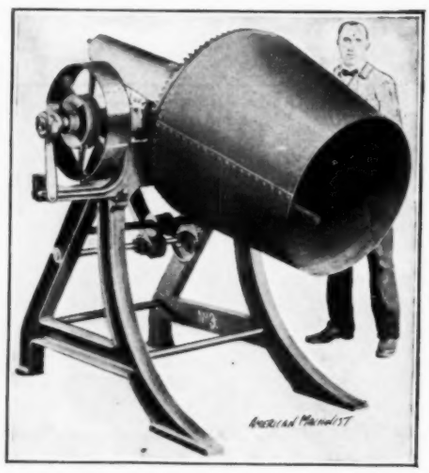


A HINGE BELT HOOK

of a series of wire hooks with long and short legs, as shown at the upper right-hand corner of the cut, which are strung on a round pin. The hooks are clinched into the ends of the belt alternately. The made-up fasteners are made in sizes from 1 to 4 inches in width and for any thickness of belt.

Large Oblique Tilting Tumbler

We illustrate a large size of the oblique tilting tumbler made by the Baird Machine Company, Oakville, Conn. This meets the demand for a machine to roll castings of medium size and weight such



LARGE OBLIQUE TILTING TUMBLER

as valves, stove trimmings, etc., and the larger sizes of chain, and similar goods. This allows the operator to put in the work and water, to inspect the articles during the progress of operation, to tilt, elevate or dump without stopping the machine, and it is fitted with a clutch pulley, with lever control near the tilting crank. The tilting mechanism, is well back geared, and renders the operation of the barrel comparatively easy. This machine will hold about 700 pounds or four bushels of work, and wood, cast iron, sheet steel, or sheet or cast brass barrels can be mounted thereon. The machine without barrel weighs about 2000 pounds.

A Dust Proof Oil Tank with Self Measuring Pump

The halftone shows an oil tank for machine-shop use, built by the Haines Oil-Measuring Pump Company, Harris-

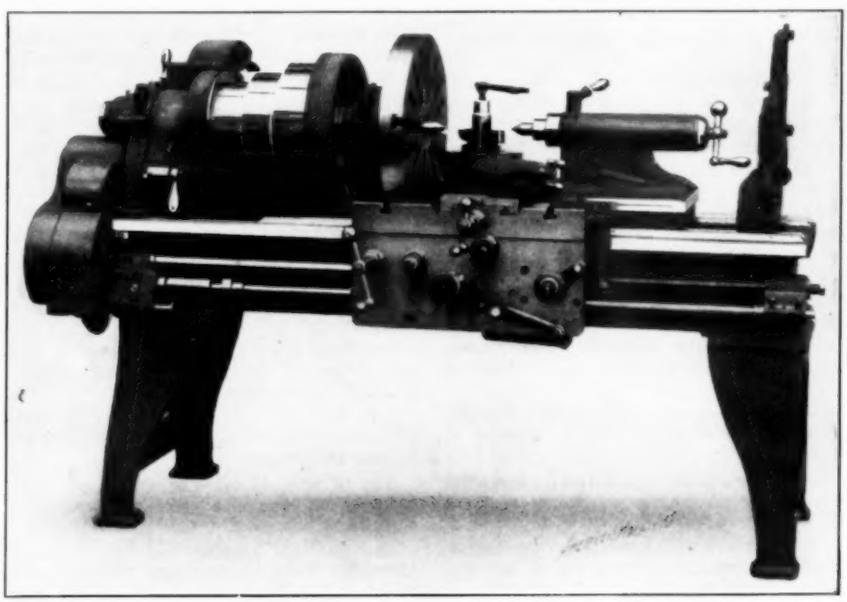
OIL TANK WITH SELF-MEASURING PUMP

burg, Penn. The tank is made of heavy galvanized sheet steel, and of any capacity desired, the one shown being able to accommodate about 70 gallons. The pump is of the self-measuring type. In the small size one turn of the handle delivers one-half pint of oil at the nozzle, and in the large size, one quart is delivered per turn of the handle. The pump is made of seamless brass tube and the valves are of brass. No rubber, leather, or other packing affected by oil is used in the construction. All working parts are inclosed and a roll top is

provided so as to exclude dust. The same concern makes a variety of storage tanks for oil or gasolene equipped with self-measuring pumps.

Heavy Pattern Lathe

The accompanying halftone shows a new 18-inch heavy pattern double back-geared engine lathe brought out by the Bradford Machine Tool Company, Cincinnati, Ohio. In the construction of this lathe the spindle, which is of high-carbon crucible steel and bored from the solid, is mounted in adjustable bronze bearings. By extending the spindle through the hood it is possible to use draw bars and tubes for draw-in attachments, which can be furnished for use with the standard spindle. In the tailstock construction the overhanging pattern is used



BRADFORD 18-INCH HEAVY PATTERN LATHE

permitting the turning of the compound rest at right angles for working between short centers. The base of the compound rest, which is gibbed throughout, is graduated in degrees. The lead-screw nut is of phosphor bronze. A chasing dial is also provided. This lathe is also made in the 22-inch size.

New Squeeze Molding Machine

The Arcade Manufacturing Company, Freeport, Ill., has recently put on the market a molding machine developed for use in its own foundry. This is of the squeezer type, the ramming being accomplished by a double-geared toggle device which applies the pressure to the mold by decreasing the travel but increasing the pressure. The vibrator is operated by a knee pad and the head is counterbalanced by a spring.

Star Grinding Wheel Dresser

The C. H. Stephan Specialty Company, Dayton, Ohio, has brought out a new dresser for grinding wheels, which consists of a tapered tube which is filled with an abrasive. Instead of having the abrasive material baked in position, it is first made as a stick of vitrified material after which it is united to the holding tube by the use of a suitable metallic material, so that it is held very firmly and is thoroughly protected against damage. A wooden handle is then inserted in the outer end and the dresser is used in the regular way.

Farwell's Molding Machine

The new portable pneumatic roll-over molding machine which is shown in the accompanying illustrations, is being placed on the market by the Adams Company, of Dubuque, Iowa.

This machine jolts the mold, turns it over, and draws the pattern; a combination of features that is new in a portable machine.

The angle-iron table *A* strikes the solid cast-iron wheels *B* at the block *C*, when the mold is being jolted, as shown in Fig. 1, the wheels thus serving as an anvil block. The jolting is accomplished by admitting air to the cylinder and then allowing it to exhaust. Both of these operations are performed with the same valve, which enables the molder to control the machine entirely with one hand.

After jolting the mold, the bottom board is clamped to it with the adjustable clamps *D*, and the whole is then rolled over into position for drawing the pattern, as shown in Fig. 2. The mold is rolled over by admitting air to the cylinder until the table carrying the mold has passed the dead center, after which the air is allowed to escape, either slowly or quickly, until the mold rests on the cross pieces *E*. The four plungers *F*, are provided with springs that automatically equalize and adjust themselves to the irregularities of the bottom board at all four points, and as soon as the mold rests upon the cross pieces, are locked in position by one single movement of *G*.

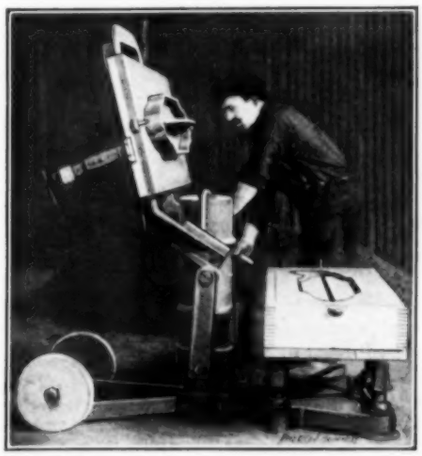


FIG. 3. ROLLING PATTERN BACK TO POSITION FOR JOLTING

The pattern is then drawn by opening the air valve with the right hand, and at the same time operating a pet cock with the left hand, to admit air to the Adams pneumatic rapper. As cylinder *H* is raised by the air pressure within, the pattern will be drawn straight up until the yoke *I* strikes the pin *J*, when the yoke must

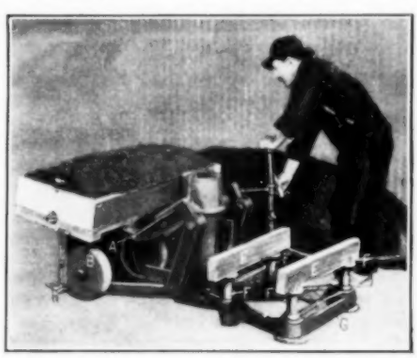


FIG. 1. JOLTING THE MOLD

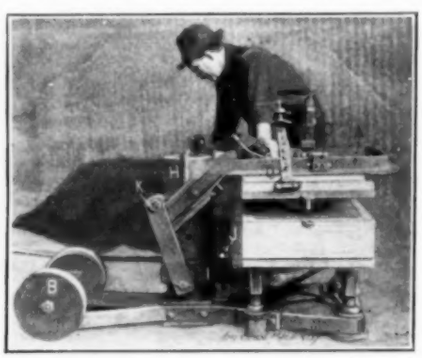
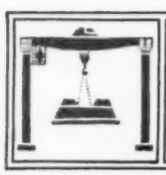


FIG. 2. DRAWING THE PATTERN

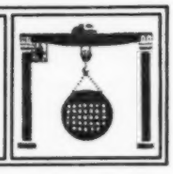
stop, making a fulcrum of the pin *K*. In rolling over, the pattern as well as the mold, describes an arc, as shown in Fig. 3. This shows the position the pattern takes when rolling it back to start another mold.

The company has also remodeled its stationary squeezer by raising the table higher above the rocker shaft and making it unnecessary for the top to swing through so great an arc in clearing the table. It has also added a 34-inch size to its heavy-duty low-down squeezers, and has adapted its squeezer to the use of the W. J. Keep hinged match-plate system, and will supply the special equipment required to any foundries that may be licensed to use the same.



Increasing Shop Capacities

Where More Tools will be needed



The Elma (Wash.) Cannery Company will erect a plant.

The town of Catasauqua, Penn., will erect a new waterworks plant.

W. H. Bailey, Fair Haven, N. Y., will erect a large produce warehouse.

The National Car Coupler Company, Attica, Ind., is erecting two additions.

The Coops Piano Company, Tacoma, Wash., is looking for another location.

The Wausau (Wis.) Fiber Company will build a plant at Trappe Rapids.

The Warner Shoe Company, Pottsville, Penn., will build a new factory.

The Boone (Ia.) Electric Light Company will spend $50,000 in improvements.

The Cincinnati (Ohio) Shoe Company will erect a factory at Georgetown, Ohio.

The Pioneer Pearl Button Company will erect a new plant in Elmira, N. Y.

The planing mill of Harry Carpenter, at Joseph, Ore., was destroyed by fire.

An addition is to be built to the foundry of Sweet Brothers, Lestershire, N. Y.

The Idaho National Harvester Company, Moscow, Idaho, will erect an addition.

The Webb Wire Works, New Brunswick, N. J., will build an addition to its plant.

Louisville (Ky.) Car Wheel and Railway Supply Company will erect a machine shop.

The Winchester (Wash.) Lumber Company expect to erect a mill of 50,000 feet capacity.

The White Pine Sash Company, Spokane, Wash., will erect a planing mill and factory.

The Moore Shingle Mill Company, Spokane, Wash., will erect a mill at Priest River, Idaho.

The Simplex Auto Company, of New York, is to build a factory at New Brunswick, N. J.

J. K. Dunn, McComb City, Miss., is to erect a tin-can factory and a canning plant.

R. L. Teeter has leased property at Perutton, N. Y., as a site for a large storehouse.

The Bunting Brass Company, Alliance, Ohio, is seeking a location for a larger plant.

The Frankford (Penn.) Knitting Company is seeking site for a new and modern plant.

An addition will be built at the plant of the Reo Motor Car Works, St. Catharines, Ont.

L. V. Wells, of Wenatchee, Wash., will build an electric-light plant at Ephrata, Wash.

The Citizens Light, Heat and Power Company, Eagle Grove, Iowa, will enlarge its plant.

The Mt. Vernon (Ohio) Railway and Light Company has obtained site for a new power house.

It is stated the Fairfield (Conn.) Aluminum Company is considering the removal of its plant.

The Indiana & Michigan Electric Company, South Bend, Ind., will erect a new power house.

Authentic news is solicited for this department. Real opportunities for the sale of machinery of any kind.

The Gamm & Porter Foundry Company, Minneapolis, Minn., will erect a new foundry building.

Lewis Brothers, Newark, N. J., confectioners, will install a new refrigerating system.

The Public Service Company, of New Jersey, will erect a large power plant at Perth Amboy.

The Jennings (La.) Electric Light and Power Company will install a 3-phase generator.

It is reported that Archer & Crow, Spokane, Wash., operating brass works, will erect a foundry.

The roundhouse of the C. P. R., at Ottawa, Canada, was damaged by fire to the extent of $12,000.

The Continental Bridge Works, Peotone, Ill., is said to be considering the removal of its plant.

The Quackenbush Company, Scranton, Penn., will erect a large warehouse at Pittston, Penn.

The Hendey Machine Company, Torrington, Conn., has had plans drawn for an addition to its plant.

C. F. Rumpp & Sons, Fifth and Cherry streets, Philadelphia, Penn., will erect a new boiler house.

The Fraser River Lumber Company, Fraser Mills, B. C., will erect a shingle mill at Anacortes, Wash.

Alb. Franquinet, rue de Pitteurs, Liège, Belgium, would like catalogs of valves, gages, boiler fittings.

The Warner & Swasey Company, Cleveland, Ohio, will soon begin the erection of a four-story addition.

The Hanford (Wash.) Irrigation and Power Company will enlarge its power plant at Priest Rapids.

The Chandler & Price Foundry, on Jackson street, Palmyra, N. Y., was destroyed by fire. Loss, $14,000.

It is stated the Independent Glass Company, of Sistersville, W. Va., is seeking another location.

The Crystal Ice Company, Crowley, La., will increase the capacity of its plant from 25 to 50 tons.

The Marquette Motor Car Company is planning extensive improvements at its plant in Saginaw, Mich.

Waite, Thresher Company, Providence, R. I., is to erect a new plant for manufacturing jewelry.

The Northern Pacific Railroad will immediately erect a new and larger roundhouse at Wallace, Idaho.

Plans have been completed for a new plant for the D. Connelly Boiler Company, at East Cleveland, Ohio.

Wm. Baker, Amesbury, Mass., is having a new brass foundry erected to replace the one recently burned.

The Griest Manufacturing Company, Westville, Conn., will build an addition to be used as machine shop.

The Great Northern Railroad is preparing plans for a heating and a cold-storage plant at Tacoma, Wash.

The Black Bear Consolidated Mining Company, Wallace, Idaho, will erect a mill on its property soon.

The Lake Superior Knitting Works Company, Appleton, Wis., is to double the capacity of its mill.

Schuler Brothers, Wilkes-Barre, Penn., will erect a large warehouse for the storage of lime, cement, etc.

The Fore River (Mass.) Shipbuilding Company is buying about $10,000 worth of metal working machinery.

The Boston (Mass.) & Albany Railroad will rebuild its heating plant and install new boilers and pumps.

The Winton Motor Car Company, Cleveland, Ohio, have had plans prepared for a three-story addition.

The National Lumber and Box Company, Hoquiam, Wash., is planning the erection of a new $25,000 mill.

The Keystone Lubricating Company, Philadelphia, Penn., will build a new factory building to cost $40,000.

The Hindley Manufacturing Company, Valley Falls, R. I., manufacturing cotter pins, is erecting an addition.

The Barbour Silver Company, Meriden, Conn., is erecting a four-story addition to its plant to cost $50,000.

The National Machinery Manufacturing Company, Inc., Rockaway, N. J., is preparing plans for a new plant.

The Irvine & Smith Gasolene Engine Company, Stanley, Iowa, is looking for site on which to erect a plant.

The Astoria Silk Works, Steinway avenue, Long Island City, will erect a new four-story factory to cost $50,000.

The Vander Steuken-Ewing Construction Company will erect a fabricating plant at South Bethlehem, Penn.

The United States Can Company, Norwood, Ohio, has increased its capital stock to provide additional facilities.

Charles Abresch Company, Milwaukee, Wis., will have a $30,000 addition built to its carriage and wagon factory.

The Columbus (Ohio) Pneumatic Tool Company has secured a permit to erect a new shop to cost $7000.

The Elwood (Ind.) Iron Works Company is considering the removal of its plant to some other town or city.

The A. T. Wall Company, Providence, R. I., manufacturing rolled plate and plated ware, is erecting a new factory.

The Fraser River Lumber Company, Fraser Mills, B. C., will erect a plant for the manufacture of sash, doors, etc.

The mattress factory of John Holman & Co., Boston, Mass., was damaged by fire to the extent of about $60,000.

The Bard Union Company, Norwich, Conn., making pipe fittings, will soon begin the construction of another factory.

The Peoples Portland Cement Company, of Sandusky, Ohio, will erect a plant at Spokane, Wash., to cost $450,000.

The plant of the Logansport (Ind.) Artificial Ice and Cold Storage Company was destroyed by fire. Loss, $15,000.

The United Cork Company, of Hoboken, N. J., is contemplating the erection of a plant at Lyndhurst to cost $150,000.

The Luzerne Rubber Company, Trenton, N. J., will erect an addition to its factory and also increase its power plant.

The North Vernon (Ind.) Lumber Company will locate a branch plant in the South if suitable location can be secured.

M. Dumoulin Ragant, rue Renoz 5, Liège, Belgium, is interested in gasolene motors, condensers, fuel economizers, tools.

The New Britain (Conn.) Carriage Company has awarded contract for the construction of a new three-story factory.

The Bissell Carpet Sweeper Company, Grand Rapids, Mich., will commence the erection of a five-story addition to its plant.

The Maxwell-Briscoe Company is preparing to erect a three-story addition to its automobile plant at South Auburn, R. I.

It is reported that Phil S. Locke, and others, of Aberdeen, Wash., will erect a power plant on the Chehalis river.

The Polleys Lumber Company, Lincoln, Neb., is contemplating the erection of a $150,000 sawmill at Missoula, Mont.

Hart Kraft Motor Company, York, Penn., making automobiles, expect to build additions and double the capacity of its plant.

The Twentieth Century Storage Company, South Bethlehem, Penn., is seeking location on which to erect a large warehouse.

New meters are to be installed and other improvements made at the municipal electric-light and water plant, at Lafayette, La.

The directors of the New Haven (Conn.) Hospital have authorized the building of a new heating and electric power plant.

The city council, of Port Angeles, Wash., has granted T. T. Aldwell a franchise to erect and operate a light and power plant.

The National Hydraulic Tire Setter Company, of Keokuk, Iowa, has commenced the erection of a plant at Springfield, Ill.

The Knobloch-Heideman Manufacturing Company, South Bend, Ind., will erect a new factory for making ignition apparatus.

Salvador Prieto, Avenida Ocampo 188, Chihuahua, Chih., Mex., would like catalogs and quotations on general mining machinery.

Ajax-Grieb Rubber Company, Trenton, N. J., will build new machine and blacksmith shop, also increase the capacity of its power plant.

The Tuttle Engine Company has purchased site at Canastota, N. Y., and will erect a plant for the manufacture of gasolene engines.

Doherty & Wadsworth, Paterson, N. J., silk manufacturers, have leased a building in which a branch factory will be established.

The King Sewing Machine Company, Buffalo, N. Y., has let contract for a new factory building, which is to cost about $125,000.

The Stahl Brewing Company and the Betz Brewing Company, of Walla Walla, Wash., have consolidated and will erect a new plant.

Adam Beck, London, Ont., manufacturing cigar boxes, is to establish a branch plant at Winnipeg and extend the Montreal factory.

The National Brake and Electric Company, Milwaukee, Wis., will erect a $150,000 addition to be used as a steel and brass foundry.

K. F. Jacobson & Co., Racine, Wis., who make a specialty of pattern work in wood and metal, are erecting a two-story addition.

The Consolidated Tramway Company, of Roanoke, Va., will erect a plant for the manufacture of material for building tramways.

The McCrum-Howell Company, Park avenue and Forty-first street, New York, is looking for warehouse facilities in Newark, N. J.

The Automatic File and Index Company, Green Bay, Wis., manufacturing filing devices, music cabinets, etc., will enlarge its plant.

C. K. Williams & Co., Easton, Penn., is to erect several additions to its plant in the near future. The company manufactures paints.

William J. Frey has purchased the plant of the U. S. Electrical Porcelain Company, at Findlay, Ohio. New machinery will be installed.

The boiler house, machine shop and blacksmith shop at the Girard plant of the A. M. Byers Iron Company, Youngstown, Ohio, were burned.

A one-story building containing patterns owned by the Coffin Valve Company, of Boston, Mass., was burned, causing a loss of $10,000.

The Maney Milling Company, Omaha, Neb., whose plant recently burned, is to replace same with a new mill and elevator to cost $150,000.

The Grann Logan Motor Company, Lima, Ohio, is having plans prepared for an automobile-making plant to consist of three buildings.

Andrew Stangle, general manager of the Idaho Butchering and Packing Company, of Buhl, Idaho, will erect an ice and refrigerating plant.

Connery & Co., 1326 North Ninth street, Philadelphia, Penn., has secured site on which a new boiler-manufacturing plant will be erected.

The Columbian Iron Works, of Chattanooga, Tenn., has been making investigation for the purpose of securing a location for a new plant.

G. W. Daniels, of Little Falls, Wash., is negotiating with the Commercial Club, at Baker, Wash., with a view to establishing a brick plant.

The Coshocton (Ohio) Light and Heating Company will soon start the erection of a new power plant to have a capacity of 25,000 horsepower.

The Marshalltown (Iowa) Power and Light Company contemplates enlarging its plant. Two 350-horsepower boilers and stokers will be installed.

S. H. Head, Stockton, Cal., representing a large iron-manufacturing concern, is trying to find suitable site for establishing a subsidiary plant.

Paul Messinger, representing the Weinhard estate, in Portland, Ore., will erect a cold-storage plant to cost about $35,000 at Eugene, Ore.

The Cincinnati Iron and Steel Company, Cincinnati, Ohio, is making arrangements to increase its capacity for getting out its "Cisco" lathe.

The Harvey Forging Company, Racine, Wis., has started the erection of a second addition to its plant, lower floor to contain a modern machine shop.

Williamson & Sleeper, 110 Utica street, Boston, Mass., manufacturing straw hats, is said to be considering plans for establishing a branch plant.

The Chicago & Northwestern Railroad has commenced the erection of a new roundhouse and machine shop at Nelson, Ill., to cost about $65,000.

The Isthmian Canal Commission, Washington, D. C., will receive bids up to 10:30 a.m., June 27, for one steel ladder dredge as per Circular No. 575.

The citizens of Fairbury, Neb., have voted on bond issue to install a lighting and water plant to cost $135,000. C. H. Denney, chairman of committee.

The Greist Manufacturing Company, Westville, Conn., will build an extension to its plant at 310 Blake street, which will be used as a machine shop.

Fire caused $15,000 damage to the plant of the Ohio Yarn Mills Comapny, Cleveland, Ohio. A $2500 knitting machine, recently installed, was destroyed.

The plant of the Olympic Foundry and Machine Company, Tacoma, Wash., partially destroyed by fire recently, will be rebuilt and entire plant enlarged.

The Bay State Grinder Company, 186 Union street, has been organized to manufacture a new piston-ring grinder and a cam and valve face grinder.

The Western Storage Battery Company, Kansas City, Mo., is looking for a location to establish a larger plant. The company will employ about 200 men.

The Connecticut Computing Machine Company, New Haven, Conn., has been partially burned out, the main damage being in the engine and boiler room.

The Firth-Sterling Steel Company, of Pittsburg, has taken out permit for a one-story workshop at No. 3 plant in Glesboro Point, D. C., to cost $13,000.

The Long Manufacturing Company, Chicago, Ill., manufacturing radiators and other automobile specialties, has had plans prepared for a new plant.

The Saginaw (Mich.) Sheet Metal Works has outgrown its present quarters at 515 Tuscola street, and is planning to build a larger and uptodate plant.

The Federal Oak-Leather Company, Main and Canal streets, Columbus, Ohio, has filed certificate increasing its capital stock and will purchase new machinery.

The Pacific Coast Coal Mines, of Nanaino, B. C., will build a machine shop and install 100-horsepower return-tubular boiler, etc., at its mine at South Wellington.

The Davison-Namack Foundry Company, Schenectady, N. Y., has awarded contract for the erection of an addition to its plant, which will almost double its output.

D. P. Hale has purchased a building on West Fifteenth street, Baltimore, Md., and will engage in the manufacture of buggies. Will erect two additional buildings.

Mayer & England have purchased ground at Seventeenth and Cambria streets, Philadelphia, Penn., and will erect a factory for the manufacture of electric supplies.

Sealed bids will be received by the Board of Water Supply, 299 Broadway, New York, until 11 a.m., April 26, for four 100-horsepower and one 150-horsepower boilers.

Wm. G. Mercer, of Burlington, Iowa, formerly of the Buffington Wheel Company, is to organize a new company and establish a factory for the manufacture of wheels.

The Standard Machine and Electric Company, Indianapolis, Ind., will erect a new shop with increased facilities for the building of electric motors and automobile parts.

The Anniston (Ala.) Foundry and Machine Company has awarded contract for the erection of new buildings at West Anniston, doubling the capacity of its present plant.

The Joliet (Ill.) Concrete Machinery Company, a new concern, has purchased land on the Mills road, south of Joliet, and will shortly commence the erection of a plant.

The Heffner Motor Car Company, which is being formed at Cleveland, Ohio, by L. H. Heffner, will probably locate its plant at Ashtabula. Plant will employ 200 men.

The Wonham-Magor Engineering Company is planning to rebuild a plant at Athenia, N. J., destroyed by fire a short time ago. The company manufactures industrial cars, etc.

The Gurney Heater Company will remove its plant from East Boston to South Framingham, Mass., where it has secured site. Plans are being drawn for a new building.

The New Milford (Conn.) Foundry and Machine Company, which has been incorporated to succeed the New Milford Foundry Company, is rebuilding its plant recently burned.

The Westinghouse Lamp Company is to erect two additions to its plant at Bloomfield, N. J., one to be a machine shop to cost $15,000; the other a six-story warehouse.

The Westinghouse Electric and Manufacturing Company is preparing plans for a steel foundry at Trafford City, Penn., which, it is said, will be the largest of its kind in the world.

Wilbur D. Greenough and others, of Spokane, Wash., will develop their water-power right on the South Fork, at Elk City, Idaho, and install a 50-horsepower motor in the near future.

The General Electric Company, Schenectady, N. Y., will establish a plant at Schaghticoke, N. Y., for the manufacture of incandescent bulbs, which are now made in New Jersey.

The L. J. Spaulding Company, Lowell, Mass., manufacturing slippers, is looking for suitable location on which to erect a large and modern plant. The company employs 300 hands.

The E. M. Uniack Manufacturing Company, 346 Greenwich street, New York, is to locate in New Brunswick, N. J. The company manufactures brass specialties, including chandeliers, etc.

The Sanitary Can Company, Fairport, N. Y., is to make extensive additions to its plant. Machine shop is to be enlarged and another engine and boiler will be added to the power plant.

Plans have been made by the engineering department of the Great Northern Railway Company for a new roundhouse to be erected at 1646 Ruffner street, Seattle, Wash., to cost $16,000.

F. S. Komp, formerly of Waukesha, Wis., has taken lease on the old rolling-mill property at Allentown, Penn., which he will use preparatory to erecting a large iron and steel fabricating plant.

The Chadwick Automobile Manufacturing Company, located at Spring Garden and Thirty-second street, Philadelphia, Penn., is reported to be looking for a site on which to erect a large and uptodate factory.

The Great Lakes Engineering Works, of Detroit, Mich., will soon receive bids for the construction of a new shipbuilding plant at Ashtabula, Ohio, for which a large amount of machinery will probably be needed.

The Willett Engine and Carbureter Company, Buffalo, N. Y., has increased its capital stock to $1,000,000 and will build a larger plant for the manufacture of gasolene engines for automobiles, aeroplanes, boats, etc.

James Herbert Manners, Teatinos 446, Santiago, Chile, would like to correspond with American manufacturers of machinery, railway equipment and engineering supplies, interested in introducing their products into Chile.

Fire originating in the boiler room of the Bunker Hill Laundry, Boston, Mass., caused a loss of about $100,000, including damage to factories of Booth & Lord, woodworkers, and Melich & Byfield, furniture manufacturers.

The Van Zandt-Moore Iron Works, Fort Worth, Tex., recently incorporated, will erect a machine shop, blacksmith shop, etc., for the manufacture of cold-storage machinery and general repair work. L. H. Van Zandt is president.

L. W. May, of the May Bending Works, Loudonville, Ohio, is planning the removal of its plant to some other place if suitable site can be secured. The company manufactures automobile rims and vehicle and agricultural rims of wood.

The Isthmian Canal Comission, Washington, D. C., will receive bids up to 10:30 a.m., May 9, for push cars, trolley hoist, angle bars, track spikes, screws, wire cable, iron and steel pipe, brass unions, flexible joints, cocks, vises, rubber belting, mineral lubricating oil, etc., as per Circular No. 574.

The Isthmian Canal Commission, Washington, D. C., will receive bids up to 10:30 a.m., May 5, for steel rails, frogs, switches, tie plates, angle bars, steel iron, rivets, bolts, nuts, iron and lock washers, chain, wire cable, wire, iron and steel pipe, boiler tubes, brass and copper tubing, lead pipe, babbitt metal, copper, brass, bronze, etc., as per Circular No. 573.

Bedell & Coleman, engineers, 237 Prospect avenue, Bayonne, N. J., will be in the market shortly for machinery for a reverberatory furnace plant in Canada, and would like catalogs of bridge- and trestle-work supplies, cranes, cables, hoisting machinery, power-transmission machinery, conveyers, elevators, ore-handling machinery, pumps, pipe, pipe fittings, pipe tools, concrete mixers, reinforcing and structural steel.

The Navy Department, Bureau of Supplies and Accounts, Washington, D. C., will open the following bids: May 3—Simplex feed pumps (schedule 2411), bolts and nuts (schedule 2411), calipers, rules, machinists' bench vises (schedule 2410), sheet brass, rolled bronze, sheet copper (schedule 2413), steel forgings (schedule 2412), black sheet iron, steel boiler plate, sheet steel (schedule 2405), carbon tool steel, medium steel, medium plate steel (schedule 2408), bronze pipe fittings (schedule 2405), water meters, cast-iron pipe and fittings (schedule 2401), steel tubes, safety spring valves, composition valves, cocks (schedule 2411), brass tubes (schedule 2413).

NEW INCORPORATIONS

Mineral Ridge Manufacturing Company, Mineral Ridge, Ohio. Foundry. Capital, $5000. Incorporators, Reuben Hitchcock, etc.

General Garage Company, Bronxville, N. Y. Capital, $60,000. Incorporators, A. H. Johnson, Bronxville; E. E. Beyer, H. A. Bemis, New York.

Hann Automobile Company, Bridgeton, N. J. Manufacture automobiles. Capital, $50,000. Incorporators, H. L. Howell, C. D. Stowell, C. A. Nann.

Victor Iron Works Company, Cleveland, Ohio. Foundry business, etc. Capital, $50,000. Incorporators, W. G. Schaal, M. J. Raus, W. M. De Vere, etc.

Vulcan Hard Fibre Company, Camden, N. J. Manufacture paper, pasteboard, etc. Capital, $100,000. Incorporators, J. S. Stubbs, D. A. Hills, M. H. Mutchler.

Ohio Insulator Company, Mansfield, Ohio. Manufacture electrical apparatus. Capital, $10,000. Incorporators, F. B. Black, A. L. Wilkinson, G. A. Mead.

Jacob Lapp Cooperage Company, Akron, Ohio. Manufacture barrels, etc. Capital, $50,000. Incorporators, Jacob Lapp, F. W. Lapp, W. O. Slusser, etc.

The Sperry Gyroscope Company, New York. Manufacture gyroscopes, compasses, etc. Capital, $500,000. Incorporators, E. A. Sperry, W. D. Carleton, E. J. Jones.

Valley Foundry Company, Canal Dover, Ohio. General foundry and machine business. Capital, $25,000. Incorporators, C. C. Klar, H. B. Klar, W. H. McBride, etc.

Crozet Ice and Cold Storage Corporation, Crozet, Va. Manufacture and sell ice. Capital, $15,000. Incorporators, W. F. Carter, C. L. Wayland, W. F. Carter, Jr.

Freeborn Hinge Top Can Company, Cleveland, Ohio. Manufacture cans and dies for making cans. Capital, $100,000. Incorporators, H. W. Church, Jas. E. Newlum, etc.

Cleveland Woodwork and Mantel Company, Cleveland, Ohio. Manufacture mantels, doors, windows, etc. Capital, $20,000. Incorporators, Louis Mintz, D. Mintz, E. E. Goss, etc.

Enid Implement Manufacturing Company, Enid, Okla. Manufacture agricultural implements. Capital, $150,000. Incorporators, F. S. Wyatt, H. J. Houghland, F. D. Kline.

Troy Roller Bearing Company, Troy, N. Y. Manufacture and deal in roller bearings, journals, etc. Capital, $60,000. Incorporators, J. B. Dingham, W. J. Brewer, P. J. Smith.

Empire State Paper Bottle Company, Gloversville, N. Y. Manufacture paper boxes, tubes, bottles, etc. Capital, $100,000. Incorporators, R. Delamatar, T. B. Robinson, C. I. Delamatar.

The Bearings Company of America, Jersey City, N. J. Manufacture bearings, balls, magnetos, carbureters, etc. Capital, $1,000,000. Incorporators, W. B. Greeley, J. W. Hertzler, A. L. O'Shea, etc.

George C. James Manufacturing Company, Cincinnati, Ohio. Manufacture printing and bookbinding machinery. Capital, $30,000. Incorporators, Geo. C. James, F. N. Craven, O. M. Craven, etc.

Midget Machine Company, New York. Manufacture and deal in machines, etc. Capital, $50,000. Incorporators, H. H. Pierce, Boston, Mass, C. B. Corell, New York; E. H. Barnet, Newark, N. J.

Jerome Gray Pure Water Company, Lowellville, Ohio. Erect water and lighting plant. Capital, $50,000. Incorporators, Andrew Kroeck, J. E. Vogan, H. D. Smith, Jerome Gray, W. M. Keesecker.

Atlantic Vacuum Cleaner Company, Jersey City, 15 Exchange place, Jersey City, N. J. Manufacture vacuum cleaners. Capital, $50,000. Incorporators, A. M. Everett, W. W. Graham, J. F. Autenrieth.

Ithaca-Auburn Power Company, New York. Manufacture electricity for light, heat and power. Capital, $500,000. Incorporators, A. H. Flint, New York; H. A. Clarke, R. L. Post, Cornell Heights, Ithaca.

The Anthony Comapny, New York. Civil, mechanical and electrical engineers, tool and boiler makers, brass founders, etc. Capital,

$350,000. Incorporators, N. W. Anthony, A. R. Anthony, D. C. Munson.

Dominion Dry Dock Company, Quebec, Canada. General shipbuilding and repairing business. Capital, $1,000,000. Incorporators, Sir Thomas Shaughnessy, president, C. P. R.; Hugh Andrew Allan, Montreal, etc.

Funk Manufacturing Company, 39 Fourteenth street, Hoboken, N. J. Manufacture mill supplies, engines and machinery. Capital, $125,000. Incorporators, F. C. Lang, A. S. Aexander, J. W. Rufus Besson.

Cleveland Motor Truck Company, Cleveland, Ohio. Manufacture motor trucks, general automoblie-repair business. Capital, $20,000. Incorporators, G. Von den Steinen, W. B. Stewart, F. C. Van Cleef, etc.

Bayonne Steel Casting Company, West Orange, N. J. Manufacture and install mechanical, electrical, etc., signaling and safety railroad appliances. Capital, $150,000. Incorporators, W. D. Sargent, Geo. M. Judd, E. H. Fallows.

The M. L. Brandt Cutlery Company, New York. Manufacture cutlery, hardware, etc. Capital, $10,000. Incorporators, M. L. Brandt, 107 Bristol street, Brooklyn, N. Y.; Benjamin Brandt and Nathan Brandt, 182 Georgia avenue, Brooklyn.

BUSINESS ITEMS

The address of the Chicago store of Norton Company and Norton Grinding Company will be changed on May 1 to 11 North Jefferson street.

Mason & Hanger, contractors for one of the siphon tunnels on the New York water-supply extension, are installing in their plant at Cornwall, N. Y., two large Ingersoll-Rand Corliss duplex air compressors, with a capacity of 5200 cubic feet per minute.

Edward Brown & Son, 311 Walnut street, Philadelphia, Penn., manufacturers of the Brown pyrometers and revolution recorders, announce the change in their name to the Brown Instrument Company, with the same officials. The new concern also announces the opening of an office in the new Oliver building, Pittsburg, Penn., in charge of W. H. Gibb, necessitated by the large amount of business done by this company in the Pittsburg district.

TRADE CATALOGS

Gisholt Machine Company, Madison, Wis. Catalog describing boring mills. Illustrated, 40 pages, 8x10 inches, paper.

Independent Pneumatic Tool Company, 1307 Michigan avenue, Chicago, Ill. Circular M showing Thor pneumatic tools.

B. F. Sturtevant Company, Hyde Park, Mass. Bulletin No. 177, describing electric forge blower. Illustrated, 4 pages, 6½x9 inches.

The Acme Machinery Company, Cleveland, Ohio. Catalog of bolt, nut and forging machinery. Illustrated, 162 pages, 6x9 inches, paper.

Max Ams Machine Company, Mt. Vernon, N. Y. Catalog C, Series 2, sanitary-car machinery. Illustrated, 106 pages, 6x9 inches, paper.

The Baird Machine Company, Oakville, Conn. Bulletin No. 300, describing oblique tilting tumbling barrels. Illustrated, 24 pages, 6x9 inches.

The Bullard Machine Tool Company, Bridgeport, Conn. Pamphlet describing vertical turret lathe for machining automobile and gas-engine parts. Illustrated.

FORTHCOMING MEETINGS

International Railway General Foremen's Association, annual convention, May 3-7, Grand hotel, Cincinnati, Ohio. L. H. Bryan, secretary, Two Harbors, Minn.

National Association of Manufacturers, annual meeting, Waldorf-Astoria hotel, May 16, 17 and 18, 1910. Geo. S. Boudinot, secretary, 170 Broadway, New York City.

National Machine Tool Builders' Association, spring convention, May 24-25, Rochester, N. Y. Charles E. Hildreth, Worcester, Mass., secretary.

American Society of Mechanical Engineers, spring meetings, Atlantic City, N. J., May 31-June 3. Calvin W. Rice, secretary, 29 West Thirty-ninth street, New York City.

Engineers' Society of Pennsylvania will hold their second annual State convention at Harrisburg, Penn., June 1-4, 1910.

American Foundrymen's Association and American Brass Founders Association; joint convention, June 7-8-9, Detroit, Mich.; headquarters, Hotel Pontchartrain. Richard Moldenke, secretary, Watchung, N. J.

National Gas and Gasolene Engine Trades Association. Semi-annual convention, Cincinnati, Ohio, June 13-16, 1910; headquarters, Hotel Sinton. Albert Stritmatter, secretary, Cincinnati, Ohio.

Master Car Builders Association; annual meeting June 15-17, Atlantic City, N. J. J. W. Taylor, secretary, Old Colony building, Chicago, Ill.

American Railway Master Mechanics Association, June 20-22, Atlantic City, N. J. J. W. Taylor, secretary, Old Colony building, Chicago, Ill.

Joint meeting of American Society of Mechanical Engineers and Institution of Mechanical Engineers, Birmingham, England, July 26-29, 1910.

American Society of Mechanical Engineers; monthly meeting second Tuesday. Calvin W. Rice, secretary, 29 West Thirty-ninth street, New York City.

Boston Branch National Metal Trades Association. Monthly meeting on first Wednesday of each month, Young's hotel. D. F. P. Clark, secretary, 309 Milk street, Boston, Mass.

Providence Association of Mechanical Engineers. Monthly meeting fourth Tuesday each month. E. C. Bliss, president, 91 Sabine street, Providence, R. I.

New England Foundrymen's Association; regular meeting second Wednesday of each month, Exchange Club, Boston, Mass. Fred F. Stockwell, 205 Broadway, Cambridgeport, Mass.

Engineers' Society of Western Pennsylvania; monthly meeting third Tuesday. Elmer K. Hiles, secretary, Fulton building, Pittsburg, Penn.

Superintendents' and Foremen's Club of Cleveland; monthly meeting third Saturday. Phil. Frankel, secretary, 310 New England building, Cleveland, O.

Western Society of Engineers, Chicago, Ill. Regular meeting first Wednesday evening of each month, excepting July and August. Secretary, J. H. Warder, 1735 Monadnock block, Chicago, Ill.

WANT ADVERTISEMENTS

Rate 25 cents per line for each insertion. About six words make a line. No advertisements abbreviated. Copy should be sent to reach us not later than Friday for ensuing week's issue. Answers addressed to our care will be forwarded. Applicants may specify names to which their replies are not to be forwarded, but replies will not be returned. If not forwarded, they will be destroyed without notice. No information given by us regarding any advertiser using box number. Original letters of recommendations or other papers of value should not be inclosed to unknown correspondents. Only bona-fide advertisements inserted under this heading. No advertising accepted from any agency, association or individual charging a fee for "registration," or a commission on wages of successful applicants for situations.

Miscellaneous Wants

Caliper catalog free. E.G. Smith, Columbia, Pa.

We buy or pay royalty for good patented machine or tool. Box 282, AMER. MACHINIST.

Light, fine machinery to order; models and electrical work specialty. E. O. Chase, Newark, N. J.

Special machinery accurately built. Screw machine or turret lathe work solicited. Robert J. Emory & Co., Newark, N. J.

Light and medium weight machinery and duplicate parts built to order; tools, jigs, etc. MacCordy Mfg. Co., Amsterdam, N. Y.

Oilstone holder, described on page 661, mailed for 25c.; shop agents wanted. F. J. Badge, 286 Taaffe Place, Brooklyn, N. Y.

Patents. C. L. Parker, Patent Attorney, ex-examiner Patent Office, 990 G St., Washington, D. C. Write for Inventor's Handbook.

Foundry with first-class machine shop and exceptional facilities desires to contract for manufacturing machines or devices of gray iron. Box 419, AMERICAN MACHINIST.

Mechanical engineer wants to correspond with firms desiring to build pumps, compressors and engines of new designs and of exceptional merits. Box 460, AMER. MACH.

A well equipped machine shop within 30 miles from New York solicits orders for all kinds of machine work. Send inquiries: The Brunswick Refrigerating Co., New Brunswick, N. J.

A large English firm of machine-tool importers having showrooms and offices in Great Britain, France, Italy and Japan, is wanting good agencies for machine tools of all kinds. Apply Box 189, AMERICAN MACHINIST.

Technical novelties will be pushed energetically by mechanical engineer (30 years), returning to Vienna, after 4 years' commercial and technical experience in the United States. Address "Austria," AMER. MACH.

Dies and press tools for sheet-metal formation designed and constructed in a modern shop, under personal supervision of the best die man in this country. For dies, presses and anything in sheet-metal formation write to Joseph V. Woodworth, Mgr. Harwood Mfg. Co., 42 South 8th Street, Brooklyn, N. Y.

Proposals for ordnance supplies. Watervliet Arsenal, Watervliet, N. Y., April 16, 1910: Sealed proposals, in triplicate, will be received until 1 p.m., May 16, 1910, for furnishing steel, hardware, forage, fuel, oils, etc., during year ending June 30, 1911. Information furnished on application. Lieut.-Col. W. W. Gibson, Commander.

Help Wanted

Classification indicates present address of advertiser, nothing else.

CONNECTICUT

Working foreman experienced in work of high accuracy, on automatic screw machines, milling and grinding; state age, experience, salary and references. Box 452, AM. MACH.

ILLINOIS

The board of education of Chicago require teachers in the following departments: (a) blacksmithing; (b) foundry; (c) machine shop; (d) woodworking; (e) electrical construction; (f) mechanical drawing; minimum requirements: The equivalent of a high school education and three years' work in his line; examinations, June 27-28, 1910. For blanks and further information, apply to the Department of Examinations, 829 Tribune Bldg., Chicago.

INDIANA

Wanted—First-class screw and turret lathe foreman; must be competent in uptodate methods and capable of getting results. Nordyke & Marmon Co., Indianapolis, Ind.

MASSACHUSETTS

First-class toolmaker; must be a hustler, used to jig work and short cuts. Box 433, AMERICAN MACHINIST.

Wanted—Two good mechanical draftsmen; location central Massachusetts; state experience and salary expected. Box 426, AM. MA.

MICHIGAN

Wanted—Toolmakers, die sinkers, lathe hands, machinists and automatic screw machine operators; A-1 men only. Buick Motor Co., Flint, Mich.

Wanted—First-class machine shop foremen; must be accurate and producers. Address Seager Engine Works, Lansing, Mich.

Wanted—Immediately, first-class machinists and diemakers; good wages, steady employment. Michigan Machinery Mfg. Co., Ypsilanti, Mich.

Draftsmen Wanted—Men to handle repair and small construction designing on machinery and special apparatus. Apply to the Solvay Process Co., Detroit, Mich.

Machinists, Etc., Wanted—25 first-class Browne & Sharp and National-Acme automatic screw machine operators; machinists and lathe hands; A-1 men only need apply. Buick Motor Co., Flint, Mich.

Wanted—First-class machinist capable of taking charge of a small shop turning out interchangeable parts; will require a man of good personality and executive ability. Box 432, AMERICAN MACHINIST.

Wanted—Machinists in Detroit; good machine and floor hands for medium and heavy work; good steady job with responsible concern to good men; state experience and references. Address Box 582, Detroit, Michigan.

Wanted—One of the oldest and best established companies in the Middle West seek the services of a general foreman for their machine shop; about 350 are employed in the department, and building and equipment are thoroughly modern; the nature of the work varies from a line similar to automobiles and manufactured in large quantities, to a medium heavy plain class of railway equipment; none but high grade men apply, as the position is an important one and requires a man of broad experience. Box 415, AM. MACH.

MISSOURI

Wanted—Draftsman capable of laying out and detailing conveyer installations, coal pockets, etc.; should have a knowledge of structural work in steel and timber; also detailer wanted for same. Box 453, AM. MA.

Wanted—Experienced draftsman; good on designing jigs and fixtures; one capable also of laying out small experimental work, such as desired in adding machine construction; state fully, experience and salary desired. Dalton Adding Machine Company, Poplar Bluff, Mo.

NEW JERSEY

Wanted—Six (6) toolmakers; none but first-class applications will be considered; men that cannot fill the requirements herein stated are not wanted. Apply at the works of Henry R. Worthington, Harrison, N. J.

Mechanical Draftsman—Large manufacturing company located in vicinity of New York City requires several high-class designers of special automatic labor-saving machinery; give full details and qualifications. Box 449, AMERICAN MACHINIST.

Wanted—Machinists; steady work for good milling, boring, lathe and floor hands; also tool and die makers; call in person if possible; cheap rents and pleasant surroundings. Ferracute Machine Company, Bridgeton, N. J. (40 miles south of Philadelphia).

NEW YORK

Hands for automatic screw machine; state experience and wages desired. Box 435, AM. M.

Wanted—First-class all-around machinists, Mosher Water Tube Boiler Company, Ossining-on-Hudson, N. Y.

First-class experienced drop forgers; steady employment, desirable surroundings. Write with references, Box 436, AMER. MACHINIST.

Wanted—Several first-class jig and fixture draftsmen. Apply by letter or personal call to Mergenthaler Linotype Company, 24 Ryerson St., Brooklyn, N. Y.

Wanted—Toolmakers on model and experimental special automatic machine work; good pay and steady work to competent men; give age, experience and references. Apply: The S. S. White Dental Mfg. Co., Prince's Bay, N. Y.

Wanted—A first-class fixture and jig draftsman familiar with automobile motor, transmission and axle manufacturing; state previous experience, references, age and salary expected. Superior Motor Vehicle Co., 1449 Niagara St., Buffalo, N. Y.

Wanted—A machinist and first-class handy all-around man for repair work in a cereal mill to do repair work of all kinds and some work in machine shop; wages $3 per day, time and a half for overtime and Sunday work; steady work the year around. Box 411, AM. M.

Wanted—We are constantly increasing our force and invite applications from the following: Machinists, lathe hands, screw machine hands, grinder hands, milling machine hands, motor assemblers, toolmakers, sheet metal die men; we run a nine-hour shop, have desirable surroundings, and offer steady position to desirable characters. Address Superintendent, Maxwell-Briscoe Motor Co., Tarrytown, N. Y.

Wanted—Practical draftsman, engines, pumps, general machinery, special tools for shop use, estimating, making up bills materials, requisitions, inspection, etc.; a capable man that has worked his way up through the shops, but well posted in theory and best practice preferred; state experience; give reference, present employer and salary desired, age. Apply to Edgar Penney, V. P., Newburgh, N. Y.

OHIO

Competent lathe and vise hands by the American Tool Works Co., Cincinnati, O.

Wanted—Draftsman, familiar with detail crane design; state wages desired. The Toledo-Massillon Bridge Co., Toledo, O.

Wanted—First-class lathe, boring mill, shaper and planer hands; inquire at once. The Heisler Company, St. Marys, Ohio.

Wanted—First-class machinists, toolmakers die sinkers, lathe, planer, drill press, screw machine, boring and milling machine operators, wood patternmakers, brass molders, polishers, buffers, finishers, spinners, millwrights, hammermen and blacksmiths who are seeking positions or desirous of improving on those which they have, to register their names and addresses with the free Employment Department of the National Metal Trades Association. Address Commissioner's Office, 605 New England Bldg., Cleveland, O.

PENNSYLVANIA

Wanted—Die setters, die makers, jig and fixture makers and wood pattern makers. Apply at Employment Department, Westinghouse Electric & Mfg. Co., East Pittsburg, Pa.

Wanted—Inside wiremen, tinsmiths, coppersmiths, sheet metal workers, Schwartz and crucible furnace hands and punch press hands. Apply at the Employment Department, Westinghouse Electric & Mfg. Co., East Pittsburg, Penn.

Wanted—We have positions to offer from time to time for the following lists of first-class mechanics: Metal pattern makers; wood pattern makers; iron molders, bench; iron molders, floor; brass molders, bench; machinists; brass finishers, Fox monitor; brass finishers, turret lathe; toolmakers; work consists of brass and iron valves and fittings. In applying for any of the above positions state age, experience and wages. Address F. E. Johnson, Supt., The Kelly & Jones Co., Greensburg, Pa.

The Monotype Company maintains a school to train young men to meet the constant demand for operators of its type casting and composing machine; these operators do so well that it receives more applications for places than can be filled. In making selections these qualifications carry most weight: Common sense, automatic machinery experience, printing office experience, type foundry experience. Full particulars will be furnished to inquirers who furnish the same information about themselves. Lanston Monotype Machine Co., Philadelphia, Pa.

Wanted—Plain, slab and portable milling machine hands, horizontal and vertical boring mill hands, automatic screw machine hands, shaper hands, universal tool and shaft grinders. Apply at the Employment Department, Westinghouse Electric & Mfg. Co., East Pittsburg, Penn.

WISCONSIN

Toolmaker, first class, one with executive ability, with view of advancing to foremanship. Answer, stating age, nationality and full experience; good opening for right man. Box 381, AMERICAN MACHINIST.

Situations Wanted

Classification indicates present address of advertiser, nothing else.

DELAWARE

Mechanical draftsman desires change; go anywhere; eight years' experience in design and installation of machinery; also experience in structural iron work. Box 455, AM. M.

ILLINOIS

Graduate mechanical engineer, six years' experience as works engineer for a company employing 500 men, desires position as engineer or superintendent; inventive ability particularly fits him for taking charge of plant having processes requiring the development of special machinery. Address "A B C," AMERICAN MACHINIST, 355 Dearborn St., Chicago.

INDIANA

Mechanic, 36 years old, with 10 years' experience as foreman and superintendent, in sheet metal manufacturing; good systematizer, and uptodate in modern methods of manufacture, desires a change by the first of June; Chicago or immediate vicinity preferred. Box 434, AMERICAN MACHINIST.

MASSACHUSETTS

Master mechanic or assistant; ten years' experience manufacturing large quantities of small parts; familiar with latest methods; salary not under $175 per month. Box 451, AMERICAN MACHINIST.

Practical man, experienced in shop, in office as draftsman and cost accountant, with good references as to ability and character, invites correspondence with parties relative to some responsible position with good future. Box 441, AMERICAN MACHINIST.

Wanted—A situation as mechanical superintendent or works manager; I have executive ability and practical mechanical experience that will meet the most exacting requirements in all departments for the manufacture of any class of mechanical goods and machinery. Address Box 439, AMER. MACH.

NEW JERSEY

Mechanical engineer, extensive shop practice, first-class designer, at present employed, would consider change as superintendent; technical. Address Hustler, AMER. MACH.

Superintendent and works manager by high class production engineer; expert on efficient methods of organizing help and engineering the reduction of costs and raising the output; mechanical engineer by profession; never failed to make good; expert at tools, dies, machinery and estimating. Address "Hustler," AMERICAN MACHINIST.

NEW YORK

Production engineer or similar position by young man having much experience; best references. Box 458, AMERICAN MACHINIST.

Practical mechanical engineer, expert on small complicated machinery; 34 (no technical graduate), wishes to work up to position of responsibility. Box 459, AMER. MACH.

Mechanical engineer with broad experience, quick comprehension, thoroughly versed in designing and handling large machine shop and erection, desires position. Box 457, AM. MA.

Production engineer, practical, ingenious, systematic, constructive and executive abilities, age 35, open for engagement; $2500 yearly expected. Address Post Office Box 935, Schenectady, N. Y.

Experienced foreman, middle aged, latest ideas, now employed, engineering work, dynamos and general machinery; A-1 hustler; can handle large force with ability. Box 427, AMERICAN MACHINIST.

First-class mechanic, well up in modern tool room and machine shop practice, 22 years' experience, wishes position as tool room or general machine shop foreman; can furnish good reference; location immaterial. Box 443, AMERICAN MACHINIST.

Mechanic, age 30, thorough technical education, with large experience in Europe and United States as designer, instrument and toolmaker, desires change; first-class references from world's known concerns. Box 456, AMERICAN MACHINIST.

Mechanical engineer with broad experience, also knows how to adapt the machinery to the local requirements and various industries, desires position as traveling engineer or represent a firm at the coming Berlin Exhibition. Box 454, AMERICAN MACHINIST.

PENNSYLVANIA

Superintendent of manufacturing plant desires similar position west of Pittsburg, on expiration of contract, July 1; good executive, good manager; can reorganize factory; desires change account lack of faith in present management; best references, including present employers. Box 461, AMER. MACH.

VIRGINIA

Mechanical draftsman, graduated by German technical college, 4 years' shop, 6 years' drafting room experience in machine tools, especially engine lathes, punches and shears, desires change; 26; single. Box 450, AM. M.

FOR SALE

For Sale—Valuable multiple drilling patents, 1794 Seneca St., Buffalo, N. Y.

For Sale—One No. 10 Baush 16-spindle drill press, for ½" drills, in first-class condition. Box 437, AMERICAN MACHINIST.

For Sale—A complete Davis-Bournonville oxy-acetylene apparatus in first-class order; has been used about one year; can be seen at the Hartford Suspension Co., 150 Bay St., Jersey City, N. J.

For Sale—One Fifield lathe 22" swing, 24' bed with compound rest, four step cone pulley, back geared, screw cutting, face plate chuck, steady rest and feed gears, all in good condition, $225. Baker Brothers, Toledo, O.

For Sale—The patents together with complete drawings, patterns, jigs, templets, for the best molding machine on the market today; a reducer of foundry costs; will dispose of the entire business at a very reasonable price. For full particulars, address 1794 Seneca St., Buffalo, N. Y.

For Sale—One Nash gas engine, 20 horsepower, two cylinder, for electric lighting, pumping or power; one Beaman & Smith horizontal boring mill; table 25 inches wide, 36 inches long; will bore 12 inches diameter, 24 inches long, and face 20 inches diameter; one 300 light J. B. Colt Co. acetylene gas apparatus. The above machines are in excellent condition, having been very little used. For further particulars and prices apply to Ridder-Ericsson Engine Co., 35 Warren St., New York.